"The Wandle-Valley Main Drainage."*

BY WILLIAM SANTO CRIMP, ASSOC. M. INST. C.E. F.G.S.

(*Concluded from page* 171.)

In order to obviate this nuisance, the sewage is in such cases brought down an incline of 30°, flowing into a bend (Figures 1 and 2) at the bottom which forms a trap. For the purpose of inspection the sewer is also carried into the manhole at its normal gradient as shown in Fig. 1. The greater part of the sewers are constructed of stoneware pipes, varying in diameter from 9 inches to 18 inches, of the kind known as "London made." The pipes were manufactured by Doulton & Co., in conformity with the usual specification. Junctions for house drains were inserted at average intervals of 50 feet. The sewers were treated in various ways externally, to prevent the leakage into them of subsoil water. As a rule the pipes were merely jointed with tarred gasket and Portland cement; in moderately wet ground puddled clay was worked around on the outside of the cement fillet, or Stanford's patent pipes were used. Where the subsoil is of an open gravelly nature containing large volumes of water, the pipes were protected with a layer of 6 inches of Portland cement concrete, formed of 1 part of cement to 6 parts of ballast. The pipes, laid at depths exceeding 16 feet, were similarly treated, to prevent their being crushed by the superincumbent earth. Long lengths of sewers, 15 inches and upwards in diameter, were constructed of rock concrete tube made by Messrs. Sharp, Jones & Co. Those so constructed are in every way of an excellent description, their accuracy of section, strength, and ease in laying, comparing most favorably with stoneware pipes. A length of Doulton's patent pipes, with ground faces and having an earthenware chair under each joint, in which liquid Portland cement was poured, while the ground faces were kept in contact by means of wedges, was laid by Messrs. Doulton as an experiment. The observed rate of leakage was the same as in the case of all the sewers constructed in wet ground, namely, 1 cubic foot per mile per minute. It is of interest to know that in this scheme the pipe-joints are so numerous that, according to the author's calculations, one drop of water falling into the sewer per second from each joint would at the cutfall amount to 25 cubic feet per minute. Sewers 24 inches and 27 inches in diameter are constructed with one ring of brickwork, a collar joint of cement mortar, and 6 inches of concrete; those 4 feet in diameter are of two rings of brickwork with a cement collar joint between the rings.

In constructing the 15 inch outfall at Wallington, immense volumes of water were met with in the Chalk on passing into that formation from the Tertiaries. It was found impracticable to construct the sewers of stoneware pipes, and iron pipes were substituted with excellent results. The trenches were excavated a little deeper than under ordinary circumstances, there being 18 inches of water flowing along the bottom as a rule. The pipes the greater part of which were 15 inches in diameter, were carefully jointed with lead in the trench, above the water-level, in lengths of about 100 feet; they were then carefully slung and lowered into position, the joint *in situ* being made by damming the water off on each side and pumping at the joint hole. About 1 mile of sewer was thus expeditiously and satisfactorily constructed.

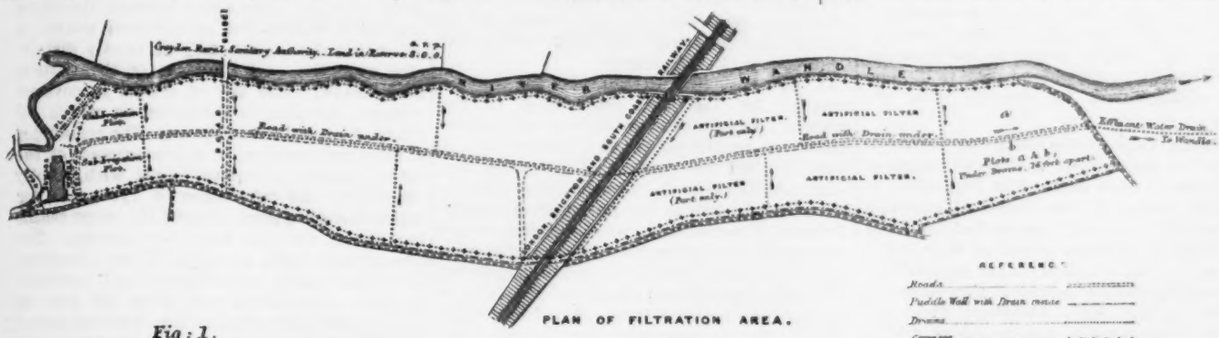
The River Wandle was crossed six times, and the railways traversing the district twenty-one times. In those cases iron pipes were substituted for earthenware, in sewers of that description, while those of brickwork were strengthened by means of an additional ring of brickwork.

Not less than 20 miles in length of the sewers are of 9 inch pipes, and, during the three years these have been in use they have acted admirably, being at the present time entirely free from sediment, while they are fully equal to all future requirements.

In the lower parts of the district, storm-water overflows are provided for the relief of the outfall sewers in case of accident, and also for use during periods of heavy rainfall.

A storm-water culvert for the relief of the Graveney was constructed. It is 350 yards in length, 8 feet in width, and it has a segmental arch and invert, its height at the center being 5 feet. In flood time the author has found its discharge to exceed 15,000 cubic feet per minute.

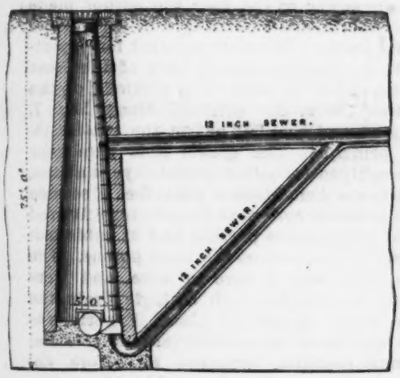
The gravitation outfall 27 inches in diameter, with a fall of 1 in 1,200; and, the low-level outfall 18 inches in diameter, with a fall 1 in 900 terminating in a tank sewer 4 feet in diameter, fall 1 in 1,000, discharge their contents at the pumping station (Figures 3 and 4). The sewage from the low-level is pumped up into the gravitation-outfall, and the whole then flows through the depositing tanks.



PLAN OF FILTRATION AREA.

Scale: 1200 Feet.

Fig: 1.



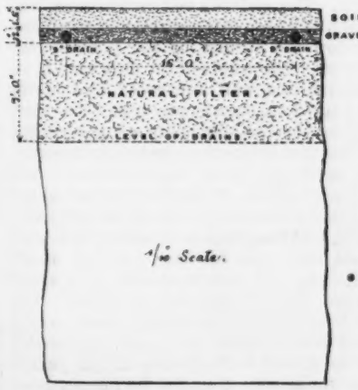
SECTION ..B

Fig: 2.

MANHOLE WITH LEAD.

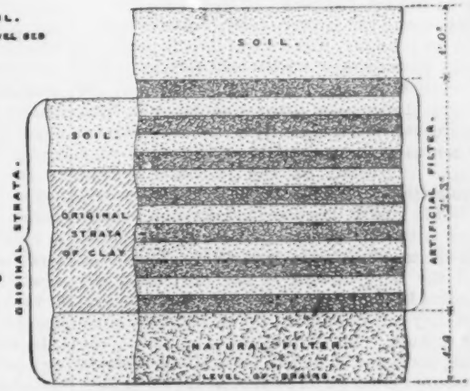
PLAN.

Fig: 6.



SECTION OF SUB-IRRIGATION AREA.

Fig: 7.



SECTION OF ARTIFICIAL FILTERS.

THE WANDLE VALLEY MAIN DRAINAGE.

* From Other Selected papers of the Institution of Civil Engineers.

The machinery for lifting the sewage comprises a pair of horizontal rotative condensing pumping-engines by Messrs. Hathorn, Davey & Co., which are of the following dimensions; Steam-cylinders 12 inches in diameter, with 20 inches length of stroke, fitted with slide and expansion valves; air-pump and condenser contained in one casting, and worked from the end of the piston-rod. The pumps are similar to those designed by Mr. Baldwin Latham for the Dantzic Sewerage Works, each pump having a piston and plunger 21½ and 16 inches in diameter, with a stroke of 20 inches; the pumps are operated directly from a disk on the end of the crank shaft, and are usually worked at the rate of 20 revolutions per minute. The sewage is lifted an average height of 20 feet. The engines also operate the lime-mixer, and the agitator used for incorporating the lime with the sludge. The boilers are of the Cornish type, 5 feet 3 inches in diameter, 14 feet in length, with flues 2 feet 9 inches in diameter, and supply steam to the pumping engines and to the air-pumps used in a pneumatic arrangement for dealing with the sludge.

In flowing through the tanks the sewage is deprived of the floating matter by means of the planks on edge at A. The deposition of the solids is aided by the cross-wall, over and under which the sewage passes before finally being filtered through a bed of coke, 4 feet thick, at B, after which it passes to the filtration area for final purification. The tanks are situated in the main building; they are cleansed twice weekly, the deposited sludge being swept into the sludge-pit on opening the penstocks. The bottom of each tank slopes towards the sludge outlet, which greatly facilitates the operation of cleansing. The sludge is treated in the following manner:—On opening the penstock, G, it flows into the mixing-well, where milk of lime is added and thoroughly incorporated by means of an agitator; thus the glutinous character of the sludge is destroyed, and the mixture is in a suitable condition for pressing. The milk of lime is prepared in an edge-runner mortar-mill having a pan 4 feet in diameter. From the mixing-well the treated sludge flows into the chamber H, from whence it is discharged into the filter-presses by means of a pneumatic arrangement of a simple character, on the juice-lift system. Two cylinders, 3 feet 6 inches in diameter, and 10 feet in length, are provided, having connections with two air-pumps, the filter-presses, and the treated sludge receptacle. The steam and the air-cylinders of the air-pumps are 6 inches in diameter, with a stroke of 6 inches, and they can be worked up to 150 revolutions per minute. On exhausting a cylinder, the sludge is forced in by the natural atmospheric pressure acting on its surface at H; when full, the valves at I are closed, those at J are opened, the engines are reversed, and air is pumped into the receivers, forcing the sludge into the presses. The whole arrangement is capable of being worked independently. One filter-press is by Needham and Kite, and the other by Johnson & Co. The pressed cakes are 2 feet in diameter, and 1⅞ inch and 1½ inch in thickness. In practice it is found that the more lime is used the quicker the operation of pressing is performed, and that, too, with a lower pressure. The following details have been supplied to the author by Mr. Chart:—

Raw sludge yielded by the tanks per week, 34 cubic yards. Lime added to ditto, 4 cubic yards. The 4 cubic yards of dry lime produce 20 cubic yards of milk of lime; therefore, the total weekly quantity of sludge to be pressed amounts to 54 cubic yards, which is reduced by pressing to 12 cubic yards of cake, and this the author found to contain 50 per cent. of moisture. The usual air pressure employed is 40 lbs. per square inch, and either of the presses would perform the work in eighty-four hours; or, practically, each cubic yard of treated sludge may be reduced to cake in one-and-a-half hour. A farmer in the neighborhood has contracted with the authorities for the cake produced during the ensuing twelve months, he paying them the sum of £42, and undertaking to keep the works free from sludge cake. The process is perfectly effectual as regards the treatment of the sludge, which is usually in sewage-works far more difficult of disposal than the sewage itself.

Some little difficulty was at first experienced through the connecting-pipes being too small; but, on using 3-inch pipes for the sludge, and on placing screens in front of the penstocks in the tanks in order to intercept large substances, no further trouble has been experienced.

It will be observed, on referring to the plan (Fig. 3), that a conduit was laid from the lime-mill to the sewers, so that chemicals can, if necessary, be added to the sewage before passing into the tanks; this, however has not been done up to the present.

It now remains to consider the method adopted for the final purification of the sewage. An area of about 40 acres of land and water was purchased for this purpose, and it is divided into two portions of 29. 6 acres and 9 acres, by the Wandle. The former area alone has been laid out for the purposes of sewage disposal, 28 acres being available for sewage purposes. The character of the subsoil composing this area varies very much, consisting of marsh clay, gravel, sand, and the detritus usually forming the alluvium found in similar valleys; the whole overlies the London clay, and is in places 17 feet in thickness. As a very large volume of sewage is dealt with on a comparatively small area as this area is surrounded by the Wandle and by other streams, and as the surface of the land is for the most part lower than these streams, it was found necessary, in order to utilize the whole of the filtration area, to construct a clay puddle wall or dam entirely around it. The wall is 2 feet in thickness, and the trench in which it is constructed was taken 1 foot below the surface of the London clay throughout. The whole of the clay used in its construction was well weathered, and it was finally passed through a pug-mill. The dam answers its purpose admirably, as was proved by the fact that before the admission of sewage to the land, the water in the subsoil was lowered throughout, to the level of the under drains. The filtration-area is about 1,000 yards in length, and 140 yards in breadth; the area, therefore, enclosed by the wall, is much smaller, compared with its length, than would be the case were it circular or square. The Lambeth Cemetery adjoins the land on one side, and in excavating the trench for the clay wall in the gravel beds existing at that part of the area, these were found to be impregnated with polluted matter, having a most sickening odor. Thus, not only are large volumes of water shut out by the wall, but also much objectionable matter. A road was made throughout the entire length of the filtration area, as nearly as possible in its center. The main drain, 2 feet in diameter, is constructed under the road; there is also a drain on the inside of the puddle-wall, connected to the main drain at intervals of about 400 feet thus dividing the filtration into separate sections. The drains inside the puddle-wall are for the greater distance parallel with the main drain, and are at a distance of 210 feet from it. The land is therefore divided into a series of sections averaging 400 feet by 210 feet nearly, and the sewage is applied on the intermittent principle.

The average depth of the drains is 6 ft.; thus there are 271,040 cubic yards of filtering material enclosed within the puddle wall, giving 15.94 cubic yards of filter per head of the present population. On laying out the filtration-area, a bed of clay ranging up to 2 feet 6 inches in thickness, and 5 acres in area, was met with, lying on porous material which in its turn rested on the London clay. As the clay was useless for the purposes of a filter it was burned into ballast, and an artificial filter was constructed in the manner shown by Fig. 6. The ballast was spread in layers 3 inches in thickness, interspersed with an equal thickness of porous soil, removed from the upper part of the land, where it was necessary to lower a portion originally higher than the irrigation level. An excellent, although somewhat costly, filter was thus constructed.

At the part of the land where the works are situated, there are some good houses in close proximity to them, and, to prevent unpleasantness to the occupants, an area of 2 acres of land adjoining the works, is laid out as shown in Fig. 5, and the sewage is applied below the surface by means of 9-inch perforated pipes 16 feet 6 inches apart, leading out from the main carriers. The space between the pipes is filled in with a bed of screened gravel in order that the sewage may be evenly distributed over the entire surface of the natural filter below. The bed of gravel is covered with soil 18 inches in thickness, on which all kinds of vegetables are grown. The remainder of the filtration-area, is, in consequence of the large volumes of sewage dealt with, wholly devoted to the cultivation of rye grass, for which there is a good demand, the crops realizing about £30 per acre per annum. The The greater part, 21 acres, of the filtration-area was merely underdrained, and carefully levelled. The drains vary from 210 feet to 16 feet apart, according to the requirements of the different soils. In order to determine the filtering power of the land, the author made some experiments extending over a period of several weeks. The plots selected for experimenting upon were typical both of the least porous, and of the most open portions of, the filtration area, the artificial filters, Fig. 7, excepted, and were laid out on the sub-irrigation principle. The gravel beds were kept thoroughly saturated for several days at a time, when it was found that 14 cubic feet of sewage per minute per acre were absorbed and filtered on the least porous portion, and 32 cubic feet per minute per acre on the most porous. The plots were each $\frac{1}{10}$ acre in area, and were merely surrounded with a single drain, the plots being square in plan. Experiments were also made on a cubic yard of artificial filtering material, arranged as before described. It was found capable of passing sewage at the rate of 2,200 gallons per day, but the sewage was merely deprived of all matters held in suspension, it was otherwise impure.

This filter, however, effectually purified 15 gallons of sewage daily, for a considerable period, and at the termination of the experiment appeared to be unaltered in character and effectiveness.

The main carriers for the distribution of the sewage nearly surround the filtration-area (Fig. 5). That on the western side is of concrete, whilst that on the eastern side is of 18-inch stoneware pipes. There are outlets from each carrier at intervals of ¼ chain, the sewage flowing into subsidiary earth carriers, from whence it is distributed over the surface of the land. The outlets are provided with regulating shutters of wood, working in stone-ware blocks with ground faces. In order to provide water for domestic and other purposes at the works, an artesian well was bored. It is 6 inches in diameter, and is lined to a depth of 200 feet with cast-iron pipes fitted with wrought-iron flush collars, the bottom pipe being provided with a steel clearance shoe. The well is of a total depth of 230 feet; the details of the strata passed through are as follows.

	Feet.	
Alluvium	12	
London clay	80	Depth to chalk 179ft.
Woolwich and Reading bed	40	
Thanet sands	47	
Into the Chalk	51	

THE WANDLE VALLEY MAIN DRAINAGE.

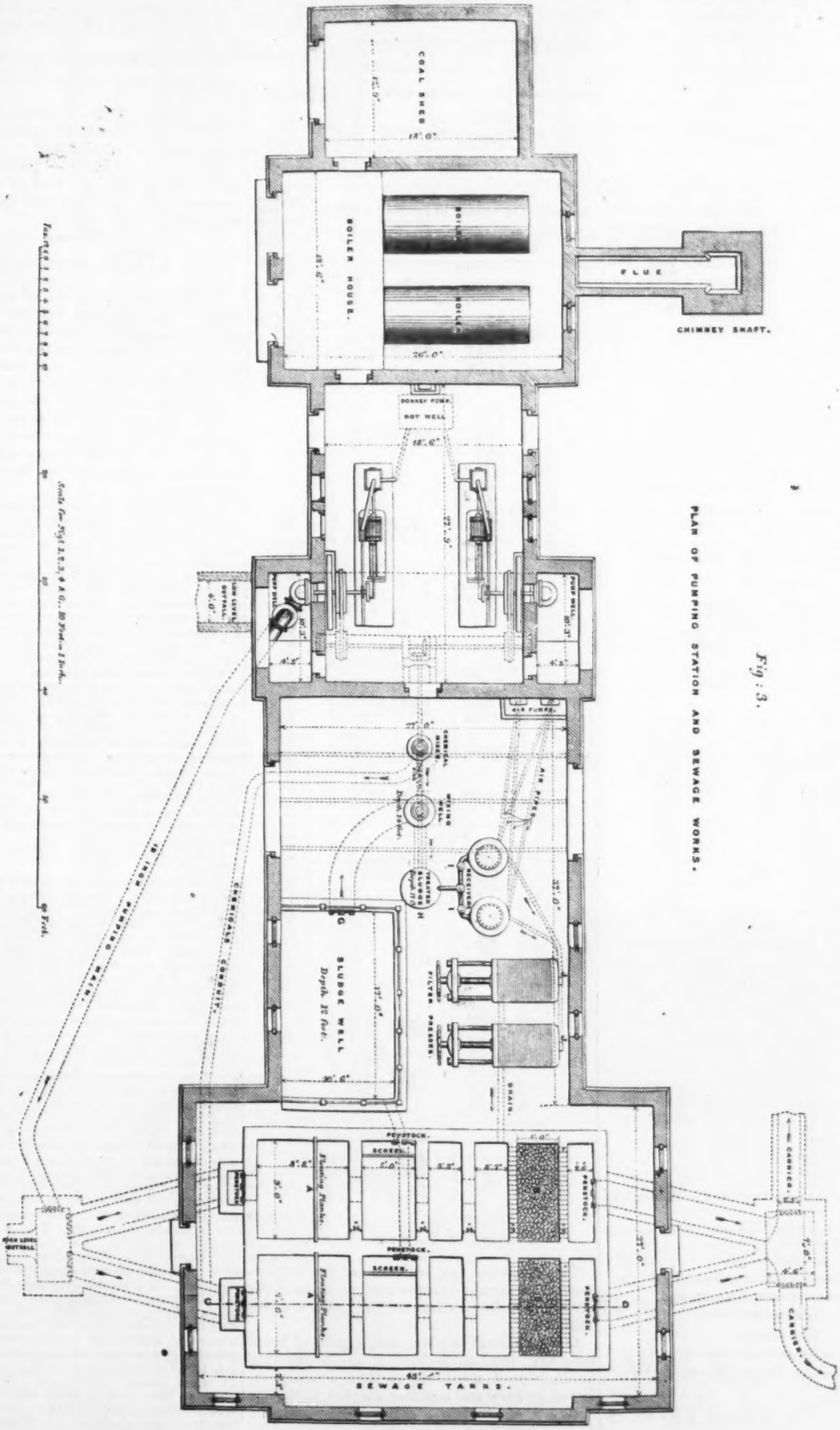


Fig: 3.

PLAN OF PUMPING STATION AND SEWAGE WORKS.

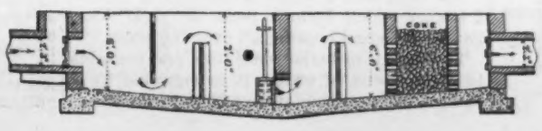


Fig: 4.

The mouth of the well is 36 feet above Ordnance Datum, and at that level the water constantly overflows, the yield being at the rate of 5.79 cubic feet per minute, or 52,100 gallons per twenty-four hours; the temperature of the water is 54° Fahrenheit. It was found by experiment that the water would rise to a maximum height of 18 feet above the surface, or to 53 feet above Ordnance Datum.

The total cost of these works, inclusive of the amount paid for the land, has been £123,000. This amount is also inclusive of the cost of the connections, engineering, and sums paid as compensation, in places where the works are constructed on private property. It is, however, worthy of remark, that the amount paid under this last head has not exceeded £2,000.

The author acted as Resident Engineer until the works were practically completed, when he accepted a public appointment. He was succeeded by Messrs. W. R. H. Chipperfield, Assoc. M. Inst. C. E., and Mr. S. Lowcock, Stud. Inst. C. E., Mr. R. Wilkinson acted throughout as Manager and Engineer for the contractors, and it is only due to them to state that no serious accident of any kind occurred, although much of the work was necessarily of a heavy character, a length of 4 miles of the sewers having been constructed in tunnel. The results of analyses, of the effluent from the filtration area, given in the Appendix, have been contributed by Dr. Stevenson.

APPENDIX.

COPY OF SCHEDULE OF PRICES RELATING TO THE WORKS

1.—EXCAVATION.

Excavation for sewer 5 feet 8 inches outside diameter, including timbering and pumping, trench taken as if 6 feet in width.

Average Depth.	Price per Cubic Yard.	Refilling and Punning per Cubic Yard.
Feet.	*s. d.*	*d.*
22	2 2	3¼
23	2 2½	"
24	2 3	"
25	2 3½	"

Trench as above, 4 feet wide.

Average Depth.		
5	1 5	"
6	1 5½	"
7	1 6	"
8	1 6½	"
9	1 7	"
10	1 7½	"
11	1 8	"
12	1 8½	"
14	1 10	"
15	1 10½	"
[1]16	1 11	"
[1]17	1 11½	"
[1]18	2 0	"
[1]19	2 0½	"

This may be done in adit where the ground is suitable. (Specification.)

Trench as above, 3 feet wide, for pipe sewers.

Average Depth.	Price per Cubic Yard.	Refilling and Raising. per Cubic Yard.
Feet.	*s. d.*	*d.*
3	1 5	3¾
4	1 5	"
5	1 6	"
6	1 6½	"
7	1 7	"
8	1 7½	"
9	1 8	"
10	1 8½	"
11	1 9	"
12	1 9½	"
13	1 10	"
14	1 10½	"
15	1 11	"
[1]16	1 11½	"
[1]17	2 0	"

increasing ½*d.* per cubic yard for every foot in depth up to 33 feet.

[1] Sixteen feet in depth and upwards. Work done in adit where ground was found suitable.

SURPLUS EARTH.

10½*d.* per cubic yard. Contractor found all shoots.

MAKING GOOD SURFACES OF ROADS.

3¾*d.* per superficial yard.

PIPE SEWERS.

Laid as described (see Paper).

Inches.	Inches.	Inches.	Inches	Inches.	
9	10	12	15	18	
s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	
2 9	3 5	4 0½	7 1½	9 4	per lin. yd.

II.

	£ *s.*	
Average cost of manholes	19 12	each.
Average cost of combined ventilators and lampholes	6 15	"
Flushing wells	32 12	"
Storm overflows	15 6	"
Engine-house, pumping and other machinery, sewage tanks, boilers, chimney-shaft, two cottages, and fencing	8,100 0	

FILTRATION WORKS.

Cost per acre.

	£
Sub-irrigation plots, complete	622
Artificial filters, complete	750

Cost per acre of natural filters.

Proportion of puddle wall, per acre	40	8	(9*s.* 3*d.* per lineal yard.
" " roads "	13	0	
" " drains "	67	6	
" " carriers (permanent)	71	0	
" " levelling	30	0	
Total cost per acre	221	14	

III.

	Acres.
Area of district drained by gravitation sewers	8,226
" " " pumped "	1,880
Population draining into gravitation sewers	15,500
" " " pumped "	1,500

IV.—RESULTS OF ANALYSES OF EFFLUENT FROM THE FILTRATION AREA, IN GRAINS PER GALLON. BY THOMAS STEVENSON, M.D., F.R.C.S., LOND., etc.

Date.	Rainfall on Three preceding Days and Day on which Sample was taken.	Suspended Matter.	Solids in Solution.	Loss on Ignition	Combined Chlorine.	Equal to Common Salt.	Nitrogen as Nitrates.	Nitrites.	Ammonia.	Organic or Albumenoid Ammonia	Oxygen required to Oxidize the Organic Matter.	Hardness.
1883. Jan. 17	Inch. 0.75 and 0.0	Traces	47.60	5.32	3.50	5.78	0.499	Traces	0.140	0.092	0.209	° " "
" Feb. 5	0.40 " Nil	"	50.26	7.14	3.36	5.54	0.638	"	0.200	0.061	0.253	"
" Nov. 20	0.01 " 0.0	"	45.08	4.76	3.08	5.08	0.363	Present	0.377	0.038	0.160	22.6
1884. Feb. 13	0.20 Nil	"	46.90	7.70	3.08	5.08	0.408	"	0.378	0.028	0.221	"
" " 28	Nil	"	45.36	9.10	3.26	5.34	0.453	"	0.340	0.095	0.185	"
" Apr. 10	0.01 and Nil	"	53.20	16.80	3.50	5.78	0.045	None	0.360	0.064	0.244	27.2
" " 23	Nil " 0.02	"	44.80	6.30	3.50	5.78	0.317	Plentiful	0.530	0.045	0.172	28.8
6h. 11.30 a.m. at noon Apr. 23	Nil	"	42.00	4.20	3.36	5.54	0.272	"	0.475	0.045	0.169	27.2

NOTE.—The details of rainfall have been added by the author.

Yonkers, N Y. Water Tower.

This structure has been erected for the purpose of supplying water to such portions of the city as are more than 250 feet above mean high tide.

It is octagonal in plan, and is built of brick masonry; the base is lined on the outside with creamy faced ashlar in random courses, relieved by axed and hammer dressed work.

Hoods of windows, and belt courses are formed with moulded bricks.

The tank floor is made of two tiers of 15 inch I beams, which form a perfectly rigid floor, having an equal bearing all over the walls.

The tank is of boiler plate iron, and contains 140,000 gallons of water; it is supplied by a compound, non-condensing Worthington engine of a capacity of 1,000,000 gallons in 24 hours, and situated at the low service distributing reservoir, about 1,400 feet away from the tower.

There is an indicator worked by electricity, in the pump room, to show the height of water in the tank.

The weight of the structure at its base is 5400 lbs. per square foot, and 3800 lbs. per square foot on the tank floor.

The tank was built by David M. Nichols, of New York City; the rest of the work was executed under contract with Denis Murphy, of Yonkers.

Under Flood Rock.

"There are four miles of tunnels in this mine," said Foreman Bernard Boyle as he conducted a visitor down into the excavations under Flood Rock, which the Government has undertaken to blow up as it blew up Hallett's Reef, a short distance above it in Hell Gate. "This is all gneiss rock," the guide continued. "Some of it is so soft that it can be cut with a knife, and some of it is so hard that it has to be blown up. The dip is at an angle of about 60° which favors the entrance of water from the river above us."

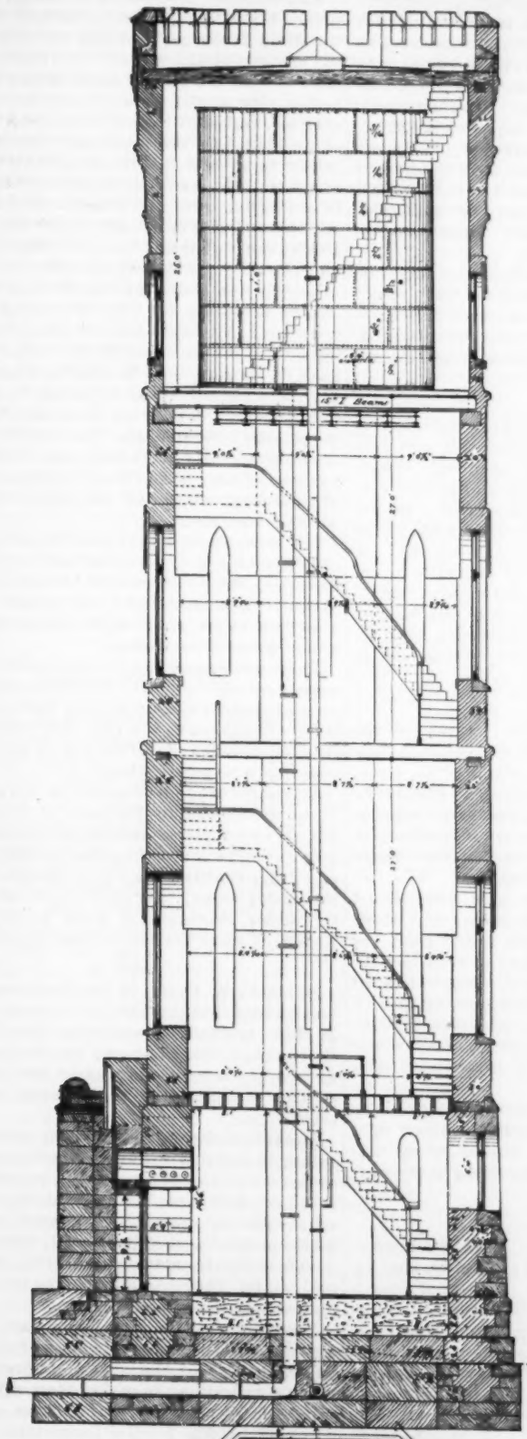
A dismal rain was pouring from the rock and threatening to extinguish the oil lamp which the explorer carried. On stepping through a doorway he found himself in water up to the knees of his high rubber boots. In the extreme northeast corner of the mine a roar was heard, and soon the water was seen rushing down through a wide seam. A number of laborers were busily engaged in cementing and in drilling test holes in new directions.

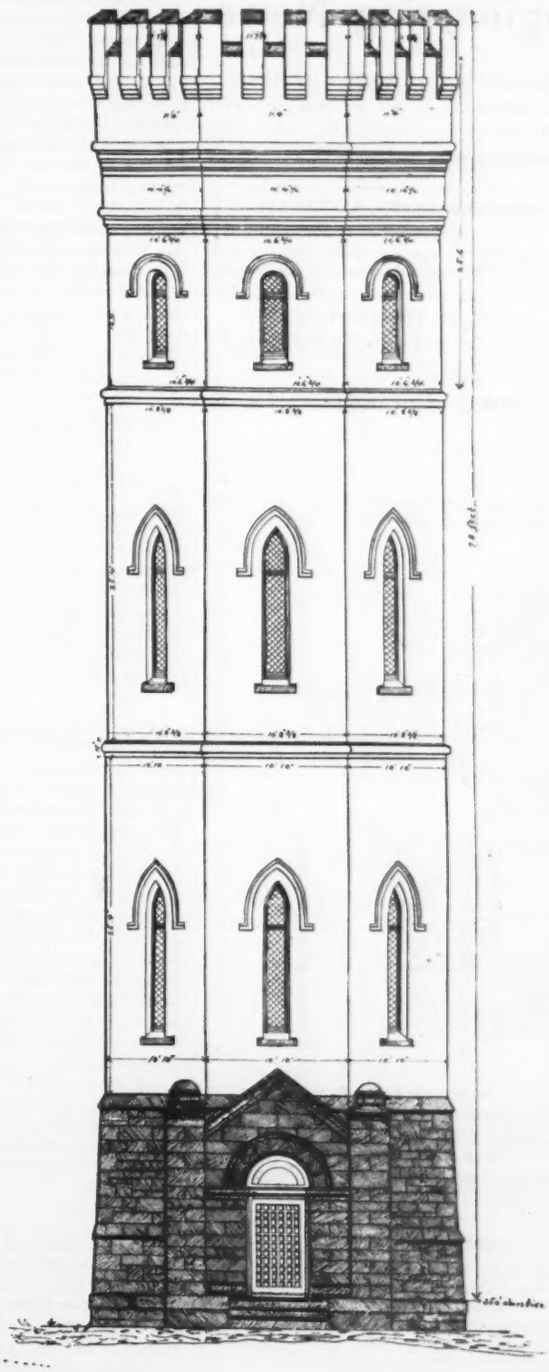
"We are working carefully now, guarding against any further outbreak," said Mr. Boyle. "There is a million dollars worth of work at stake here, and we are exercising the greatest caution. In case of a sudden flood the miners would escape through the door there and close it. Then the compressed air of this pipe would be let loose and a pressure of sixty pounds to the square inch would prevent this section from filling. The pumps are well able to take care of the present leaks. We might introduce the compressed air into the seams there and stop it no doubt, but as we don't know the width of the orifice further back we prefer the slower process of cementing."

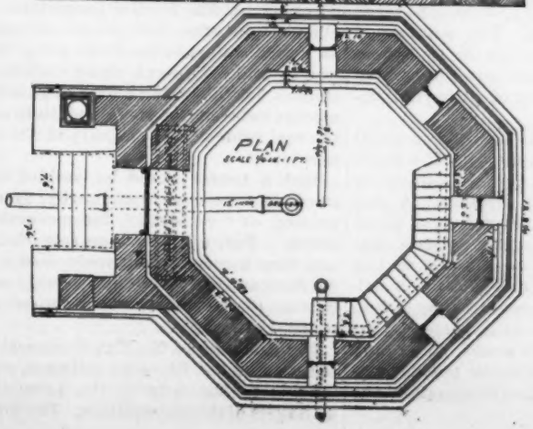
"When shall you be ready for the great explosion?"

"In about one year from this month. There are only ninety men engaged here now, although we have had two hundred or more in times past. Our present force can complete the work by the time we are ready for the explosion. You would be surprised at the number of men who apply for work in such a mine. You see, we keep a uniform temperature here the year around, and plenty of good fresh air. Some of the men have been here from the start, and we keep the old hands as long as possible. No one has ever contracted the caisson disease here. The men are temperate and we never allow the use of liquor.

"Next September you may see and hear the largest explosion known to history. All of these holes you see there with plugs in them will be filled with explosives which will cost $360,000. About 100,000 cubic yards of rock have already been excavated. Whatever we can carry out now will not have to be fished up by divers and grapplers in the form of débris after the explosion. Men are busy here night and day. If you desire to count, you will find about 250,000 two and three-inch holes drilled for explosives already. The drills have to be sharpened 50,000 times per year in the shops overhead. The rock, after being mined, has to be hoisted, carried away to deep water, and dumped. A hole seventy feet deep, just north of Blackwell's Island, has served largely as as our dumping ground. The work requires drilling, blasting, hauling, hoisting, dumping, pumping, timbering, transporting, surveying, sounding, and many other things. Every hole has to be drilled with mathematical precision to meet some other hole. We try to keep twenty feet and upward of rock for a roof, which requires an accurate knowledge of the depth of water above it. Ventilation is kept up by a fan twelve feet in diameter, driven by an engine. The large galleries ventilate themselves. The pumping operations are necessarily continuous. The average inflow from leakage at low tide is 740 gallons per minute, but the last great leak, which you noticed a few minutes ago, has increased it to over 1,000 gallons.—*Sun.*







YONKERS WATER WORKS;

HIGH SERVICE

TOWER.

W. W. WILSON, C. E.

(*For Description see page* 184.)

Engineering News

AND

AMERICAN CONTRACT JOURNAL.

Tribune Building, - - - New York City.

THE ENGINEERING NEWS PUBLISHING CO. PROPRIETOR.

PUBLISHED EVERY SATURDAY.

CONDUCTED BY

GEO. H. FROST, - - - Assoc. Am. Soc. C. E.
D. McN. STAUFFER, M.Am.Soc.C.E.: M.Inst.C.E.

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THE New York edition of the B & O. Red Book is out, and a very cleverly complied little volume it is. The scope of state information is somewhat larger than heretofore essayed in the Red Book series, and to attempt an enumeration of the contents in full would require considerable space. Suffice it to say that the publication is worth far more than the stamp and the trouble of forwarding one's address to C. K. Lord, Baltimore, the requisite for receiving a copy.

As a result of the all-day-Sunday-five-cent-fare system inaugurated on the Elevated railways on last Sunday, the official returns show that the lines carried 64,828 more passengers, but lost $1,000.75 on income over the corresponding Sunday in 1883. The increased operating expenses for the day were $2,800.

On last Sunday the number of passengers carried on all the lines was 216,605, and the revenue was $10,833: the rain and the fact that the lowering of the fares was not generally known, made it unfair to base comparison upon this first day's experiment.

To maintain the present daily revenue with a five-cent fare at all hours, the lines would have to carry 110,000 persons each day more than they do now, this increased travel would, of course, necessitate a considerable increase in operating expenses.

THE Fifth Annual Report of the Ohio Society of Surveyors and Civil Engineers is just published. It is a neat and handsome octavo pamphlet of 136 pages, containing the Proceedings of the meeting of the Society held at Columbus last January, together with all the papers then read. There is so much of indispensable value to surveyors and also to engineers that we must refer all such as are interested to the book itself, which can be had for the very low price of 25 cents a copy by addressing the Secretary, Benj. Thompson, at Urbana, Ohio.

AT the first meeting of the Trustees of the Brooklyn Bridge held since June last, the treasurer reported total receipts for June, July and August as amounting to $222,329.25, and the expenditures for the same time as being $95,779.54. The number of passengers crossing the bridge in the three months named was 3,108,860, and vehicles 143,920.

Six of the bridge arches have been rented out at $10,600 annually. In twenty-five of the arches on the New York side nothing has yet been done, and as there are applications for them, the committee on arches was instructed to take into immediate consideration the fitting up of these openings. According to some of the members present such outlay would pay an interest of probably 20 per cent. upon the amount expended.

On motion of Mayor Low, a resolution was adopted providing for the appointment of a committee to draft an act for the future control of the bridge to be presented at the next Legislature.

THE International Prime Meridian Conference, now in session in Washington, has decided by a vote of 21 to 3 in favor of Greenwich as to the prime meridian; San Domingo voted against it and France and Brazil abstained from voting at all. One of the most convincing arguments advanced in favor of the Greenwich Standards was that a tonnage of shipping equal to 14,000,000 tons was now controlled by it, while only 1,735,000 tons made use of the Paris Standard. The counting of longitude continuously through the 360 degrees or 180 degrees East and West was left optional with the nations as a matter of little vital importance.

An effort was made to discuss the metrical system of weights and measures, but the President ruled that it was not a proper subject for discussion at the present meeting. In this connection, however, Gen. Strackey, of Great Britain, said he was authorized to state that his country had asked to be allowed to join the metrical Convention, and that the metrical system was already recognized by law in England and in use for scientific purposes, but he could not say that it would under any circumstances, be adopted as the popular system of weights and measures thoroughout the kingdom.

THE Citizens' Association of Chicago offer a prize of $500 for the best practical essay on the Main Drainage, Sewerage and Water Supply systems of Chicago and its vicinity. It is desired that the essays shall discuss the subject in view of the present condition of those systems, and shall consider the best method of providing for the immediate and also the future requirements of the population in those respects. The question should be considered in connection with the Chicago river and the slips; the Des Plaines River and the Ogden Ditch; the Canal and the Fullerton Conduit, and should have special reference to a mode of securing an abundant supply of pure water, and of providing for the disposition of the sewerage. All suggestions of plans for carrying into effect the views of the writers should have due regard both to efficiency and economy, and should be accompanied by descriptive drawings, so far as necessary to make them easily understood. The subject should embrace the City of Chicago and such of its suburbs as may properly use the same means of obtaining water and the same system or lines of drainage.

The competing essays must be delivered to the Secretary of the Association on or before April 1st, 1885, and be signed by some designation corresponding with the mark upon a sealed envelope, which shall contain the name and address of the writer.

Three gentlemen will be selected by the Association to act as judges, and their names will be made public as soon as they have signified their willingness to act, and they will also determine whether any of the essays are of sufficient merit to receive the prize.

All essays are to be considered the property of the Association for purposes of publication, but the envelopes containing the names of the writers will be destroyed without being opened, excepting that bearing the designation of the successful essay. For particulars address J. C. Ambler, Secretary, or John L. Thompson, President, at 35 Merchants' Building, Chicago, Ill.

JUDGE C. E. PRATT, of the Supreme Court, has decided that the Tax Commissioners erred in their method of assessing the Elevated Railways of this city; and has revised their figures in such manner as to save nearly a million of dollars to the companies' interested.

The principles embodied in the opinion and ruling of Judge Pratt are interesting to other corporations and to investors in general. The rule here laid down for ascertaining the personal estate of a private corporation is to first fix the actual value of its capital, and then deduct from this the actual value of the company's real estate. The remainder will be the assessable value of the personal estate.

The point is made that the market price of a stock is not always indicative of its actual value, because of the system followed by so many corporations in giving their entire capital stock for property, to purchase credit or cover up profits for the promotors. As the object of taxation is to assess property upon its actual value, Judge Pratt asks "is it not proper and competent, under certain circumstances, for the taxing officer to go behind the market value of the stock and thus ascertain the real value of the property of the corporation?"

Such a course would be justified when the stock had become temporarily greatly depressed or "cornered" for speculative purposes. For, as the Judge remarks, in the one case a corporation would escape its just burdens and in the other it would suffer by reasons of the unauthorized actions of other parties.

The difficulty of the Tax Commissioners in the case of the Elevated railways, was attributable to the acts of the promotors and managers of the corporations. The Judge says

that it is difficult to believe that the structures, if paid for in cash, would have cost over $400,000 per mile, and it is certain that no value was ever received by the Manhattan Co. for the $13,000,000 of stock with which it took up its bonds.

But the actions of the promotors of these corporations in no wise effected the taxing affairs, their duty was plainly, under the law, to ascertain what property was subject to taxation and to assess it at its actual value; learning for themselves the cost from personal examinations. This, Judge Pratt declares, was not done by the Deputy Tax Commissioners or Assessors, who took figures furnished them by the superiors, the Tax Commissioners.

In the case of the Manhattan Co., the Assessors were bound to take into consideration the plain fact that the company was insolvent, the leases having proved an injury to it, and that, therefore, its capital stock represented no actual value, the company merely possessing the right to operate two other companies whose property had already been taxed. And in regard to the assessing of the structures themselves, it is declared that the deduction of 30 or 40 per cent. of their cost, as is usual in other real estate, was not done in this case. By applying the principles, Judge Pratt has revised the figures of the Tax Commissioners with the result stated above.

Philadelphia Bridges.

Philadelphia is actively at work on much needed repairs to three of its bridges across the River Schuylkill.

At Market Street, the temporary bridge erected by the Penna. R. R. Co., in 1875, to replace the one destroyed by fire, is becoming dangerous to travel. Although no contract has been let for the stone bridge proposed at this place, the authorities have deemed it wise to erect at once the temporary wooden bridge provided for in that connection. The contract for this temporary bridge was let to R. A. Malone & Sons, of Lancaster, Pa., and D. S. Cofrode, of Jersey City, is now at work upon it. The bridge will be a wooden Howe-truss, resting on timber trestles founded on cribs filled with stone. The bridge is located about 100 ft. above the present structure, and the cribs are now in place. It is expected that all work will be completed by Feb. 1. 1885.

At the Chestnut St. Bridge, Messrs. Anderson & Barr, Engineers and Contractors, are at work at the strengthening of the west abutment. This bridge has been giving trouble for years, owing to the fact that the entire western approach, arch-piers and main abutment rest upon piles driven into a very soft, laterally yielding marsh mud. The thrust from the west river arch has been gradually pushing the masonry, and to such a degree that there was danger of a final collapse. Various attempts have been made, to stop the dangerous movement westward, but so far without success. The present plan is a novel one which we expect to furthur illustrate as the work progresses. It will suffice to say at present, that the firm mentioned have contracted to sink a series of iron cylinders 8 ft. in diameter, and afterwards filled with concrete, on an angle of about 45°, and extending from the foundation masonry of the main abutment to the bed rock. These column struts are located about on the line of thrust from the main arch and are expected to make the structure thoroughly stable.

The whole is new, and the progress of this work will be watched with interest by Engineers. Compressed air will be used in connection with an air-lock of a very complete and original design, and although the execution of the work will require exceeding care and skilled supervision, the long experience of the Messrs. Anderson & Barr on work of this nature will undoubtedly insure success.

At the South Street Bridge, the western arched approach, destroyed by settling some of the piles under the end of one of the arch-piers in 1877, is now being replaced by an iron structure. Stone piers are being built upon the old foundations, all of which are in good condition save the one mentioned. On these piers will be posts of latticed channels, supporting plate girders. The roadway will be Belgian block on iron buckle-plates. The foundation masonry of the wrecked pier is now exposed; it is perfectly unbroken and the excellence of the masonry is attested by the fact that it is necessary to blast it to remove the stone. It descended almost vertically about 15 ft. into the soft mud, apparently crushing the piles beneath it. The north end is about 8 ft. lower than the south, where the gravel below rested directly upon the rock. An undischarged stratum of mud between the gravel and the rock at the north end, where all the original settlement occurred was the immediate cause of collapse.

The new cable road on Market Street and on 7th and 9th streets is rapidly approaching completion. The work upon the cable tubes seems to be of a most excellent character. These tubes are wrought iron, firmly braced, and are imbedded in concrete to within a short distance of the surface; the tube itself is the patent of Mr. A. Bonzano, of the Phœnix Bridge Works, and has already been illustrated in this journal. It is expected that the road will be in operation in the very early part of next year.

Evils of Railroads in 1830.

The *New York Gazette* of Sept. 20, 1830 gives the following humorous argument, which it says, was used by a canal stockholder in opposition to railways: "He saw what would be the effect of it; that it would set the whole world a gadding—twenty miles an hour, sir!—Why, you will not be able to keep an apprentice boy at his work; every Saturday he must take a trip to Ohio to spend the Sabbath with his sweetheart. Grave, plodding citizens will be flying about like comets. All local attachments must be at an end. It will encourage flightliness of intellect. Various people will turn into the most immeasurable liars; all their conceptions will be exaggerated by the munificent notions of distance—'only a hundred miles off! Tut, nonsense, I'll step across, madam, and bring your fan,' 'Pray, sir, will you dine with me to-day, at my little box at Allegheny?' 'Why, indeed, I don't know—I shall be in town until twelve. Well, I shall be there, but you must let me off in time for the theatre.' And then, sir, there will be barrels of pork, and cargoes of flour and chaldrons of coals, and even lead and whisky and such like sober things, that have always been used to sober traveling, whisking away like a set of sky rockets. It will upset all the gravity of the nation. If a couple of gentlemen have an affair of honor, they have only to steal off to the Rocky Mountains, and there no jurisdiction can touch them. And then, sir, think of flying from debt. A set of bailiffs, mounted on bomb-shells, would not overtake an absconded debtor—only give him a fair start. Upon the whole, sir, it is a pestilential, topsy-turvy, harum-scarum whirligig. Give me the old, solemn, straight-forward, regular Dutch canal—three miles an hour for expresses, and two for jog or trot journies—with a yoke of oxen for a heavy load! I go for beasts of burden; it is more primitive and scriptural, and suits a moral and religious people better. None of your hop-skip-and-jump whimsies for me."

Proposals for the equipment of an incandescent electric light plant on Ward's Island, will be received at the office of the Department of Public Charities and Correction, No. 66 Third avenue, in the City of New York, until 9,30 o'clock A. M., of Friday, October 31, 1884.

An Eminent Man.

At Willard's Hotel this week I ran across one of the most eminent men of the age. There are men whose names take up far more space in the newspapers, but among all the Americans of my acquaintance there is none whose career is to me more interesting than his, while I am certain that in achieved pecuniary success no one surpasses him. This was Mr. B. B. Hotchkiss whose machine guns are today the wonder and delight of the military men of every government of the world. Mr. Hotchkiss, whose career began in Connecticut before the war, and whose attention was drawn to military inventions by the developments in our war, and afterward more especially by those of the Franco-Prussian war, is now the employer of between 1,500 and 2,000 men in France and other European countries.

I have heard Mr. Hotchkiss's personal income estimated by his friends as high as $3,000 a day. He is 57 years of age, and I fancy his only anxiety is for his own health, which has been somewhat broken during the past six months. He came over from Paris a few weeks ago chiefly for the benefit of the sea voyage, taking the slowest French steamer he knew of, and found himself much improved when he got to New York. His venerable father still lives in Connecticut, and after visiting him Mr. Hotchkiss came down here to have a chat with General Benet, Captain Sicard and other officers who are especially interested in the subject of gunnery. He will go back in a week or two and spend the summer in Switzerland. His trouble all comes from that common American health-destroyer—overwork.

Mr. Hotchkiss said to me that his best friend in Europe is Sir Joseph Whitworth, the great steel manufacturer, who at the age of 84 retains personal direction of every department of his great works at Manchester. Whitworth makes the best steel in the world, and Mr. Hotchkiss will use no other for his gun barrels. Sometime ago General Darr, the French commander, came to the Yankee gun-maker, and told him he ought to use French steel instead of the English article for the guns he made in France. Mr. Hotchkiss's reply was that he was compelled to use the best steel he could get, and he would be perfectly willing to use French steel whenever he could find any as good as Whitworth's. Thereupon he began a fresh set of tests of the best steel he could buy in France, and up to date more than a hundred gun barrels have been sent to him, yet the French manufacturers have not attained the perfect quality of Whitworth's steel. Mr. Hotchkiss has had a standing offer from Whitworth for years, of an interest of a quarter of a million dollars in the works at Manchester, provided he would unite his forces with Whitworth and devote some attention to business there, but Mr. Hotchkiss has more business than he can attend to of his own, and is obliged to decline this very handsome offer.

Mr. Hotchkiss's guns sell for from $1,000 to $3,000 apiece, and, although his works have been constantly enlarged, his orders have been for years in advance of the supply. France has been thus far his best customer, but Germany is also a quiet and liberal buyer of the wonderful Hotchkiss gun. The Russian, Swedish, Dutch and other continental governments have given him large orders. He is now considering the idea of establishing works in Italy, and has just received his first order from the British government, which has adopted his new single-barreled six-pounder gun, and in all human probability will give him orders amounting to more than $5,000,000 in order to supply itself with a sufficient number of guns to complete its naval defenses.—[From the Capital.]

Engineering News Three months for One Dollar.

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from Page 176.*)

Pinch Bar, (Fig. 9) made of 2 ft. 6 in. of 1⅜ in. square, 1 ft. 3 in. of 1¼ in. round, and 1 ft. 3 in. of 1⅛ in. round, tapered and with steel end as in "lining bar." When finished to be 5 ft. long and to weigh about 26 lbs. Can make about eight in a day. The point to be "chisel" point and slightly turned up so as to get a hold when prying. The use of this bar is to hold up a tie in place when being spiked, or it is handy in the continual requirement of a bar that can lift and pry up. The heavy bar as called for in the tool list is one of this type made of 3 ft. of 1⅜ in. square, 2 ft. 6 in. of 1¼ in. round and 2 ft. 6 in. of 1⅛ in. round. Length when finished 8 ft. and weight about 41 lbs. Such a bar is used in raising low joints or in any hard lifting.

FIG. 9—PINCH BAR. Weight 26 lbs.

FIG. 10—CLAW BAR. Weight 30 lbs.

Claw Bar, (Fig. 10) commences with 2 ft. of 1½ in. square with upset end and 3 in. of 2 in. square cast steel welded in for the claw. Then 18 in. of 1⅜ in. round and 18 in. of 1⅛ in. round. When done to be 5 ft. long and weigh about 30 lbs. On account of care required only three can be turned out in a day. The forming and shape of the claw needs great attention, and considerable skill to make perfect. The angle of the claw with the bar should be about 45°, which gives a convenient angle for a man to drive it under a spike head. Some bars have a long curve connecting claw with the bar so that the latter is about at right angles with the former. This is called in track parlance a "high-heeled" bar and with it a spike can be drawn without putting a rest or "bait" under the heel. But such a bar is to be avoided as it invariably bends the spike, while the one previously described, although requiring a maul or block under it to give it height to draw the spike, nevertheless will extract it so that it is not rendered unfit for further service.

Picks. (Fig. 11) The best pick is one with a solid cast steel eye which will not split with use. Such picks must be bought. If however it is necessary to make them, they can be constructed as follows: Two pieces of iron ¼ × 2 × 12 in. with cast steel ends welded on, the two pieces welded together and drawn out so that length over all is 2 ft. 6 in; eye oval 2 × 3 in. and 2½ in. deep. Weight about 7 lbs., and eight to ten can be produced in a day.

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Tamping Picks, are made in the same way as common picks with a piece ¾ × 3 × 3 in. welded on one end.

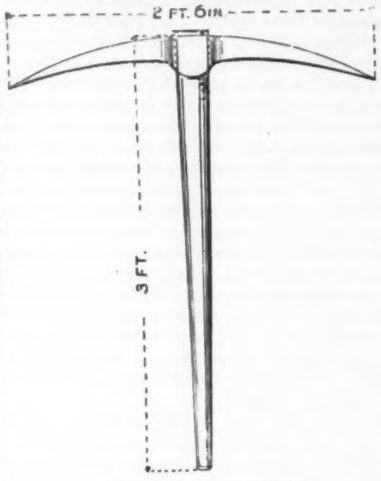

FIG. 11—PICK—Weight 7 lbs.

Grub Hoes. (Fig. 12) These are very useful tools in cutting roots and grubbing heavy sod, and the like preparatory to new work; also handy in ditching and removing tough grass from the side of the track. One is made of ½ × 2 in. iron with an adze edge at each end both steel shod. One of these is horizontal and the other perpendicular or in line with the handle so that it can be used as an axe. Length over all 16 in. and length of cutting edge 3½ in. Eye like a pick 2×3 × 2½ in. deep. Weight 5½ lbs. and five or six can be made in a day.

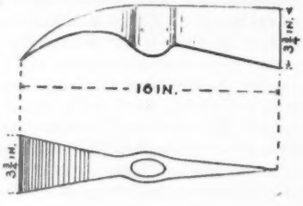

FIG. 12—GRUB-HOE—Weight 5½ lbs.

Wrench. (Fig. 13) Extreme length 21½ in. handle made of 1 in. round iron with steel jaws flat and ⅞ in. thick. Weight 5½ lbs. and daily out-put fifteen. The end of the handle is drawn out tapering to ½ in. so that it can be shoved through bolt holes in spliced bars and rails in order to bring the holes opposite when putting them together. Wrenches made longer than this give a man such leverage that he can twist off the bolts without applying great force, a needless and expensive proceeding.

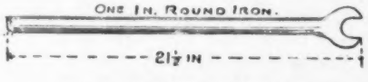

FIG. 13—WRENCH—Weight 5½ lbs.

Chisels (Fig. 14) made of 1½ in. square cast steel 6½ in. long. Eye punched in center and then one end tapered out for a cutting edge, the sides of which should not be too lean or point will break. The distance from center of eye to bit 5½ in., and 3½ in. to head, making total length finished 8¾. Weight about 4 lbs. Twenty-five to thirty can be made in a day. Great skill is required in giving the bit a good shape and especially a correct temper. If latter is too hard the chisels will break in use and it will dull if too soft. Thus sometimes one rail will use up four or five chisels while at another time one chisel will cut four or five rails.

A good chisel should cut three or four rails. In winter they are particularly apt to break and therefore the first blows given them should be easy. It is even a good plan to warm them before using in very cold weather. The length for handle should be about 18 in. which is requisite for the man holding it to keep out of the strikers way. As regards cost of repairing dulled or broken chisels sixty to seventy-five according to condition can be put in shape in a day. If however they are only slightly dulled the track-men can generally sharpen them on their grindstone.

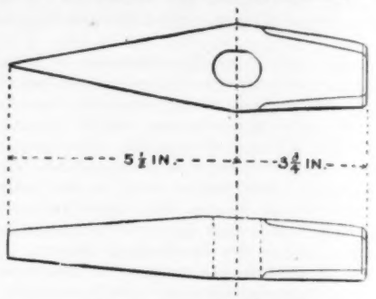

FIG. 14—CHISEL—Weight 4 lbs.

TO BE CONTINUED.

The Thermometer as used in Gauging Small Streams of Water.

Chief Engineer Ritter has lately made an ingenious application of the physical law of the mixture of fluids to the rapid determination, by the aid of the thermometer, of the approximate ratio of delivery of two small streams of water at their point of confluence.

This law of physics is expressed by the formula

$$\frac{Q'}{Q} = \frac{t - \Theta}{\Theta - t'}$$

Q and Q' being the two volumes of water at the temperatures t and t', which after their mixture, take the common temperature Θ.

In properly using this formula it is necesary that the temperatures t and t' of the two water courses be taken simultaneously, or as near together as possible, and that the temperature Θ be also taken at the same time at the confluence but at a distance sufficient to insure their thorough mingling.

It is also necessary that the temperatures t, t' and Θ be sensibly different, and, at the points examined the temperature of the air be uniform over the three points.

In making his observations M. Ritter employed a mercury thermometer with a small bulb, graduated to fifths of a degree centigrade. The divisions are engraved on each side of the tube, so as to present error of reading by parallax.

With these thermometers, each division being about one *millimetre* in length, M. Ritter could note $\frac{1}{150}$ of one degree; and as the errors of observation of any one observer are of like degree, each of the quantities $t - \Theta$ and $\Theta - t'$ is known to the $\frac{1}{150}$ or $\frac{1}{150}$ of a degree.

The relative delivery of the two streams can thus be obtained with an approximation greater or less, as the temperatures of the two streams differ more or less from each other.

The first of two experiments made, had for a purpose the determination of the delivery of the Aqueduct de la Dhuys, and that of the water of the Marne sent into this aqueduct by the works at Saint Maur; the latter quantity being known as measured by the pumps.

The ratio of delivery of the Dhuys as compared with the delivery of the waters of the Marne was found, by the method of M. Ritter, to be 2.52. As the measured delivery per second of the Marne water was for that day 114.7 litres, it was concluded that the delivery of the Dhuys should be 288.9 litres. By actual gauging the same evening the quantity was actually found to be 294.6 litres.—(*Les Annales des Travaux Publics.*)

Prevention of Water Waste in Boston.

The annual report of the Boston Water Board for the year ending May 1, 1884, was presented to the City Council on the 13th inst.

A large portion of the report is devoted to a statement of the results accomplished in the prevention of waste of water in that city, and as the Boston authorities have made extensive experiments with most of the different methods of waste prevention, the report is of special interest. Experiments have been made with the Bell Waterphone, invented by T. J. Bell, Superintendent of the Cincinnati Waterworks, and used there with marked success; with the Church stopcock, an invention of B. S. Church, Chief Engineer of the new Aqueduct Commission, and with the Deacon waste water meters. A large force of house to house inspectors have been employed, and the number of recording meters has been largely increased.

The greater portion of the saving effected, which amounts to between eleven and twelve million gallons per day, has been accomplished by house to house inspection, aided by the Deacon meters.

The following table shows the daily aggregate and *per capita* consumption from the Cochituate Works for the first eight months of 1883, in comparison with the same months of 1884:

	1883		1884			
	Daily Average Consumption Gallons.	Gallon Per Head Per Day.	Daily Average Consumption Gallons.	Gallon Per Head Per Day.	Per Cent. Reduction.	Reduction Gallons Per Day.
January	34,715,500	97.8	32,162,300	88.4	10	2,553,200
February	32,690,700	92.0	24,598,000	67.5	26.6	8,092,700
March	34,110,700	95.8	23,711,960	65.0	32.1	10,398,800
April	30,617,600	85.8	21,505,700	58.8	30.0	9,111,900
May	32,169,500	89.8	23,708,500	64.6	28.1	8,461,000
June	33,419,200	93.3	26,184,600	71.2	23.7	7,234,600
July	36,774,000	102.4	25,409,000	68.9	32.7	11,365,000
August	37,141,000	103.2	25,065,000	67.7	34.4	12,075,800
September	33,645,000	93.2				
October	29,573,800	81.9				
November	28,839,300	79.6				
December	30,174,200	83.0				

Inspection commenced in August, 1883.

With regard to the different systems of waste detection the report speaks as follows:

These figures and the results accomplished by the Inspection and Waste Division, demonstrate beyond question the wisdom, as well as the paramount necessity, for the adoption of measures to permanently check the prodigal waste which prevails. Unless some radical system be adopted which will keep the consumption down to 60 gallons or less *per capita*, the tax-payers of Boston will be compelled, at a very early day, to expend several hundred thousand dollars in the erection of additional reservoirs, and several millions of dollars in obtaining a new source of supply.

The city of Providence, with relatively the same industrial interests and class of people as our own community, keeps her consumption down to about 36 gallons per head per day. That of Boston for July, 1883, was 102 gallons per head each day, and in July of the present year, under the inspection system, 69 gallons per head. It will be observed that, even with this great reduction of the present year, we are still using nearly 100 per cent. greater amount of water *per capita* than our more prudent neighbor.

In Providence, however, it should be said that more than 50 per cent. of her consumers are supplied by the meter or measurement system, while with us scarcely 10 per cent. are supplied by this method; and that Providence is, perhaps, the only city in the United States which has undertaken to manage its water interests with the same reference to business principles that prevails among business men everywhere. We predict that all the large towns and cities will be compelled to follow her example in the near future.

In connection with the house-to-house inspection system, and as a natural and necessary supplement thereto, the Board adopted the policy recommended in its December report (see page 50), and which was substantially as follows:

1st. To put recording meters on all manufactories, breweries, stores, business establishments, hotels, tenement-houses, and all other places where a large quantity of water is used, or where waste prevails.

2d. To establish Deacon waste-detectors in the residential portions of the territory supplied with water, making specific districts, and doing the work in conjunction with the house-to-house inspection.

3d. To begin the putting in of side-walk stopcocks at once, adopting the Church stopcocks as the best complement to the Deacon, if the further trials continue to prove its excellence.

Reference to the report of Water Registrars Davis and Cardwell, and Superintendent Cutts, will show that recording meters have been applied in accordance with this original plan. The meters used have been largely those of the Tremont pattern, and have been furnished under the conditions of the bond of the company, as set forth upon page 28 of the September report. They have been delivered as fast as the city could use them, and have proven generally satisfactory, both with reference to workmanship and accuracy; and we have no occasion to find fault with the manner in which the company has met all our requirements, and discharged its bonded obligations to the department.

The Deacon system of waste-detector is at this writing (September 1) fully applied to the Cochituate Department. It will be remembered that this system was thoroughly tested in the Mystic Department, in 1882, by Assistant Engineer Dexter Brackett, and was most heartily approved and recommended by Mr. Henry M. Wightman, the Engineer of the Board, and Alderman Greenough, the chairman of the Water Committee, before the present Water Board was appointed. To these gentlemen, therefore, should be given in large part the credit of introducing this very efficient system into Boston, the first city in the United States to adopt it. We now have some 75 of the Deacon detectors in operation, and the work being done by them is of a very satisfactory character.

The Board was directed by the City Council, on the 19th of December, 1882, to make an examination of the merits of the Church stopcock. In accordance with this instruction a very elaborate and thorough series of tests were made last year, under the supervision of Assistant Engineer Dexter Brackett, and a full report of the same appeared in the report of December 6, 1883, page 40. Since that time Mr. Henry M. Wightman, Engineer of the Board, has made various experiments with this stopcock, and several important changes have been made in it as the result of his suggestions. The inventor, Chief Engineer B. S. Church, of the New York Aqueduct Commission, has also made a very valuable addition to the instrument, by means of which the particular floor upon which the water may be leaking or running is indicated on the dial attached to the stopcock in the sidewalk.

The Board has been conducting tests and experiments with this invention for more than 12 months, and is satisfied that it is altogether the best stopcock, for general purposes and water-waste detection combined, ever invented. No city or town having a water supply should be without a complete system of sidewalk stopcocks. Every service applied in Boston for the past few years has been accompanied by such a stopcock. The failure of our water authorities to apply them originally was a grave mistake, and one which no other large community save New York has committed. The plan of the Board, following the recommendation of the Engineer, is to gradually apply these instruments until the city has its full complement. At this writing (September 1), the Church stopcock has been adopted by the Board, and 5,000 of them have been ordered:

We have also made extensive experiments with the Bell waterphone, which has been used very successfully in Cincinnati and Philadelphia, and is about to be introduced in New York. Our experiments, however, were not successful, for the reason that, in the absence of sidewalk stopcocks, wires were used to connect the waterphone with the service-pipe, and the results were unsatisfactory. We contemplate giving this system another trial, at an early day, in the Mystic Department, where sidewalk stopcocks exist, and where the same conditions will obtain as in other cities in which it has met with success."

The report of the city engineer, Mr. H. M. Wightman, contains the following on the subject:

This saving has been effected by the system of house-to-house inspection, aided in some portions of the city by the use of Deacon waste-water meters. The operation of the Deacon meters, and the results which have been accomplished by their use, have been given in detail in previous reports. (City Docs. Nos. 122 and 173, 1883.)

In all cases they have been found of great value in the economical suppression of waste, and, as a result of the trials made, the system has been adopted for permanent use.

Sixty-three meters have been ordered, and are now being received and placed in position. These, with the 12 previously purchased, will supply the means of placing nearly, if not quite all, of the residential portion of the city under the control of the system.

Experiments have also been made with the Church waste-detector and with the Bell waterphone.

The details of the experiments with the Church detector or stopcock, are given in detail in City Doc. No. 173.

The waterphone has been and is used in other large cities of the country with good results, in the reduction of the consumption; in fact, this result can be accomplished by the use of most of the so-called waste-detectors, by water meters, and by house-to-house inspection.

Any of these methods will, if faithfully carried out, accomplish a large saving in the consumption; but what is desired is the best means of accomplishing the saving, taking into account facility of introduction and operation, convenience to the public, and economy both of introduction and maintenance.

All the experiments which have been made in this city have indicated that the Deacon system is the one which will best fulfill the above conditions.

In order that the Deacon system may be worked to the best advantage it is necessary to have shut-off cocks in the sidewalks, for the purpose of testing the house services.

As the greater portion of our services are not yet provided with these shut-offs the system cannot be used to the best advantage; but there is no question but the consumption can be easily reduced to 60 gallons per head, — a saving of 33 per cent. on the consumption of the past few years."

The result achieved in Boston proves conclusively that the enormous waste which has been allowed in almost all of our cities can be easily prevented. In a few cities some steps have been taken toward this end, but with these exceptions the plan seems still to seek new sources of supply, build new pumping machinery, and lay larger mains at a cost of millions of dollars for the sole purpose of providing water to be recklessly thrown away. The Boston authorities have begun a good work, and the sooner Chicago, New York, St. Louis and Detroit follow their example, the better will it be for those municipalities.

Cost of Working English Steam Tramways.

We have just received the following particulars of the working cost for the past twelve months of the engines referred to in use on the Dewsbury tramways, where they have been running for the past 4½ years. The line is equiped with nine Merryweather engines:

	Cost per Mile run. d.
Coke	0.72
Oil and waste	0.11
Water	0.02
Firewood, etc., for lighting	0.02
Locomotive repairs	0.59
" drivers	0.83
Coke, watering, and relief man	0.11
Cleaners	0.17
Total cost of working per mile.	2.57

We believe that these figures are the best yet shown by any makers of steam tramway locomotives. It will be noticed that the renewals and repairs only amount (after over 4 years' work to 5 per cent. per annum on the cost of the engines. It may be interesting also to note that the weight of coke consumed throughout the year has averaged 6.54 lb. per mile run, the number of miles traveled being 141,065.—*Engineering.*

The Stone Dam at Mechanicsville, N. Y.

The recent trouble with the dam of the Holyoke Water Power Company across the Connecticut River at this city makes pertinent an inquiry concerning the strength of the dam and the progress that has been made in dam building since this one was constructed. The first dam was built at Holyoke in 1848, but it was swept away like an egg shell after the first closing of the gates, before the water behind it had attained its full height. The dam was poorly constructed of wood, and offered but little resistance to the mighty mass of the water of the river. The present dam was completed in the following year—1849. It was made of wood, with a ballasting of stone and gravel. The bed-rock was excavated to a depth of six feet and in the excavated place 15 in. square sticks were laid lengthwise across the river and bolted to the rock with 3,000 1¼ in. iron bolts. The dam thus arose in 170 sections, adjoining sections being 6 ft. from center to center, and being tied to each other by 12 in. square sticks running across the river. The structure was made up of alternate courses of ties and rafters, 12 in. square. Short blocks were introduced between the rafters to prevent their bending, and the foot of each rafter was fastened to the rock with 1¼ in. bolts. The whole upstream surface of the top course was covered with 6 in. plank; the upper part of this surface with courses of plank, making 18 in. of solid covering. The crest was covered with boiler iron three-eighths of an inch thick to protect it from the blows of drift wood and ice. The spaces between the timbers were filled with gravel and stone to a height of 10 ft. the full height of the dam being 30 ft. The bed of the river above the dam was graveled for 70 ft., and the graveling covered 30 ft. or more of its sloping surface, which was 92 ft. from foot to crest. The masonry of the bulkhead, abutments and waste weir was made of heavy ashlar work, resting on the bed-rock; and on the bulkhead, 140 ft. long and 46 ft. wide, a gate house was built.

Through the want of a high apron in front, water, ice and drift wood began to undermine the dam in the course of 18 years, and in 1868 a large apron 50 ft. wide, with a perpendicular front of 5 ft. and a sloping front to the top of the dam, was constructed of crossing timbers with the spaces filled with rock and gravel. In the dam, exclusive of the apron, 4,000,000 ft. of lumber were used. The heavy ballasted apron gave the dam what was probably a necessary bracing, and has saved it, no doubt, from dissolution years ago. The cost of the apron was $350,000.

Notwithstanding this immense apron and the strength that it gave to the dam, and the constant repairing that the dam has required and had in the last 15 years and longer, the structure has lately shown signs that it cannot much longer resist the pressure of the stream, and the owners and the Holyoke manufacturers have become fully convinced of the necessity of a new dam. The water has recently made a large break in the dam, and the escaping water was so considerable as to seriously shorten the quantity taken out by the canals.

The manufacturers who use the water power of the river have formed an association to protect their interests, and in a conference with the Water Power Company learned that it was accumulating a fund to build a new stone dam at a cost of about $1,000,000, and which will require three to five years to build. The trouble with this dam awakens wide interest, as it is one of the large dams of the country, being, 1,017 ft. in length and exceeded in size, we think, by only one—the dam across the Schuylkill at Fairmount Park, Philadelphia. There is and need be no apprehension, however, that the Holyoke dam will break away bodily and float down stream. Of this there is not the slightest danger. The worst to be feared is leakages which may be difficult to handle as they may occur, but the Water Power Company now have the "crib" or floating coffer-dam,—which it really is—with which the recent break was successfully handled, on hand for use in any future emergency that may occur, and will be able to make quick work with any new break that may appear, should any such put in an appearance.

In the light of the present science of dam building, the Holyoke dam is certainly an antiquated structure. No dam to withstand the pressure of so large a river as the Connecticut would now be built of wood, even in part. Stone masonry and iron are recognized as the only dam materials of the present day.

For the purpose of comparing the new with the old way of building dams, a representative of *The Paper World* lately visited the dam of the Hudson River Water Power and Pulp Company across the Hudson river at Mechanicsville, N. Y. The construction of this dam began on May 29, 1882. The western portion of the stream was cribbed and the bulkhead was built of granite masonry, and was surmounted by a brick gate house. The stream was then cribbed for the dam, and the water mostly flowed through the head gates. The slate rock bed of the river was channeled for a depth of two feet, until all loose strata and seams were passed and the solid rock reached. This was swept clean, and course upon course of Sandy Hill granite and rubble was laid in hydraulic cement until the dam was completed 16 ft. high. The dam is 18 ft. broad at the bottom, has a crest 8 ft. wide and is 1,000 ft. long, including the bulkhead and anchorages. The overfall is 795 ft. long. The front slant of the dam is 2 in. to a foot rise, and the upstream is 3 in. to a foot rise. Extending above the dam on the bed of the stream is a filling of broken slate, with a foot and a half slant to one foot rise. The upstream side of the dam is in rubble work, and the face of the structure is lock faced ashlar work.

There are 12 gate openings to admit water to the canal, each 8 ft. by 10 ft. The canal is 115 ft. wide, 16 ft. deep, and is now about 400 ft. long. It can be extended 1,500 ft. further, which will be done next year for the purpose of selling power. The only wood in the whole dam and gate house is in the gates; all else is stone, cement, iron and brick. The dam was completed in December, 1882. A flat apron 18 ft. wide was built in the Summer of 1883, to guard against the breaking up of the bed-rock in front of the dam by ice, driftwood and water. During one winter and spring these agents had begun to do their work, and the slate strata were giving way under the tremendous pounding they were receiving. The apron was made of wood and that, too, in one year has been partly broken up, and could not long survive demolition if preparations were not now making for its preservation and for the breaking of the concussion of the stream of water and its floating solids, by building a large slanting apron. This will rest on the flat apron, and will be composed of iron trusses, supporting a roof or deck made of hemlock timbers a foot square covered with five inches of hard wood. The apron will rise to within 1 ft. of the crest of the dam, rising a foot and a half to 1 ft. incline. The contract for building the whole apron has already been let to R. F. Hawkins, of Springfield, Mass., the structural iron founder, and work is now under way or soon will be. The contract calls for about 250 tons of iron.

With this apron in place, this dam may be expected to endure for centuries without repairs. It must live as long as all the mills that will ever be built to utilize the water turned aside by it to their water wheels. It may cost more than a wooden dam, but it will not call for rebuilding in 35 years as the Holyoke dam has, nor in 100, nor, probably, in thousands of years.

At the very lowest water, the power of the Hudson at Mechanicsville is about 2,000 horse power. The available power during all the seasons ranges from that amount to 17,000 horse power. The location is about a mile north of Mechanicsville village, and it was bought by the Hudson River Water Power & Pulp Company with the intention of founding a second Holyoke. This company owns 150 acres of land on both sides of the river, and will proceed to make canals, sell building sites and lease power to manufacturers. Next year the present canal will be extended for new mills. For a year the company has had in operation on the west side of the river several large connected mills, fully covering 400 by 100 ft., for making chemical fiber, their daily product being 50,000 pounds. About 250 horse powers are in use. Eventually, a canal will be made on the east side of the stream, so that water may be used by mills that will be built there. William Wilkinson is president of the company; H. J. Medbery, secretary; and W. A. Healy, treasurer. Mr. A. L. Johnson, of Mechanicsville, made the plans for the dam and all the works and superintended their construction. The company already owns ten to fifteen tenements for the use of the workmen, and will build others as they are needed.

The annoyance of vibrations has been caused by the water falling over this dam. Doors and windows rattle, when air and water are just right, all over the village of Mechanicsville, and for a circuit of two miles around the dam. This will be stopped when the new apron is built. There is nothing dangerous about these vibrations at Mechanicsville, but at other places they have been serious. The Amesbury (Mass.) mills of the Hamilton Woolen Company were at times thrown into vibrations by the water falling over their dam, and a waste gate had to be opened each time to stop them. At Centerdale, R. I., the water occasionally caused a great vibration in the adjoining mill; and the water falling over the Holyoke dam before the apron was built often made synchronous vibrations of windows and doors all over the city. Nearly all large dams have aprons nowadays, so that they make no vibrations. When the annoyance of danger occurs, however, it may be averted by changing the key note of the vibration by breaking up the solid sheet of the falling water into many separate falls.

The Mechanicsville dam and bulkhead are models of their kind, and with the new apron attached they will be unexcelled as substantial structures, and in their endurance of centuries of time and flood and weather. Holyoke people must have such a dam at some time not far in the future, and then they, too, will complacently contemplate the action of the elements and the force that their dam will be prepared to resist for ages.—*The Paper World.*

WATER.

FONDA, N. Y., has decided to have a system of water-works.

THE Brenham, Tex., Water Company has been chartered. Capital $60,000.

PLANKINGTON, DAK., has contracted for a system of water-works.

THE Mitchell Dak., artesian well struck flowing water at a depth of 315 feet, but the supply is small and the boring will continue.

THE first fine has been imposed under the new city ordinance of Denver, Col., which is designed to check the waste of artesian well water.

SPRINGFIELD, MASS., a city of 33,000 inhabitants has already spent $1,276,000 on its system of water-works and the insufficient supply now threatens to render the expenditure of $450,000 for another 36 inch main, necessary.

THE Cunningham Iron Works, of Charlestown, Mass. are now setting up what is said to be the largest pair of bending rolls east of Pittsburgh. These rolls weigh 18 tons and are capable of bending a steel plate 10½ feet wide, 30 feet long and 1¼ in. thick. They will be used in filling contracts for tank and reservoir-work.

FROSTBURG, MD., is agitated over the water-works question. There is at present a private company which supplies the town with water from a large spring. By an act of the last legislature the town is empowered to issue not more than $35,000 worth of bonds, to purchase the present works or build anew. Before this act can be enforced, however, it must be ratified by a three-fifths vote of the people, and the discussion has been upon such ratification which was, however, refused at an election held for the purpose Oct. 14th.

A CITIZEN of Nashville Tennessee, in a letter to the *American* demanding a new source of water supply for the city, thus reviews the present system:

1. The machinery in use at present is either too weak or too much worn to be entirely reliable.

2. The reservoirs we already have are restricted in extent and of insufficient altitude to fully supply the city, especially at the higher points.

3. The impurity of the water now supplied is well known and is extremely objectionable.

JOHN LOCKWOOD, Hydraulic and Gas Engineer 52 Broadway, N. Y., has obtained the right of way and has let the contract to build water-works at "Far Rockaway," Long Island; the pipe is of wrought-iron, and is nearly all laid, the pumping house is built, pump set, etc.; a stand pipe is to be erected 20 feet in diameter, and 100 feet high; the works to be completed this fall. Mr. Lockwood has also secured the right of way for building works next season at Haverstraw on the Hudson to be supplied by gravity, and also at Hoosick Falls in this State, not yet decided whether to be gravity or pumping.

DURING the past year the Sioux City Water Co., have been putting in a system of water-works for that city The water is to be supplied by fifty-two "driven wells," from which it will be pumped into reservoirs some 200 feet above the general level of the city. The Holly Co., furnish pumps and engines. Works to cost $100,000 and to be purchased by the city when completed. Ten miles of cast iron mains have been laid. Forty-five hydrants. No connections have yet been made. Sizes of mains, 16", 12", 8", 6" and 4". E. B. Spaulding is Secretary and Treasurer. L. F. Wakefield is Engineer.

THE contract for the new pumping engines for the Toronto, Ont., Water Works has been awarded to Messrs. Inglis & Hunter of that city. The specifications provide that the engines and pumps shall have an easy capacity of 12,000,000 of imperial gallons in twenty-four hours against a resistance equal to raising the water from 10 ft. below the zero level of the lake to 216 ft. above zero level, being the highest level of the reservoir, through 10,000 ft. of 30-in. and 17,000 ft. of 24-in. mains. There must be guaranteed a duty of not less than 70,000,000 foot pounds per 100 pounds of coal consumed, whilst pumping under the ordinary conditions of supply to the city. The test will be ascertained from the actual records taken at the works, extending over a period of 30 days, during which time the engines

will be operated at contract speed during such hours each day as may be necessary to maintain the supply to the city. The whole of the machinery, except the steel cranks, wheels, and pinions, is to be built by the contractors in the city of Toronto. The engine will cost $55,844, and must be placed in the pumping house in working order within eight months. It will be guaranteed by the contractors for one year.

PROPOSALS for constructing sections A and B of the new Croton Acqueduct will be received till the 29th inst. The portion for which bids are invited is in the Tunnel, and is divided into two sections, viz:

Section A: Extending from a point near the High Bridge northward a distance of about 11,850 feet, and having three working shafts.

Section B: Extending from the end of Section A northward a distance of about 12,300 feet, and having two working shafts.

Security required, $125,000 and $135,000 respectively.

NEWS OF THE WEEK.

Railroads and Canals.

Macon, Ga., is to have a new street car line.

THE machinery for the Philadelphia cable roads is in place.

CHICAGO capitalists have taken up the project of a road from Monroe, La., to Pine Bluff, Ark.

IT has been decided to extend the Wisconsin, Pittsville and Superior 25 miles northwesterly from Pittsville.

THE Lehigh Valley R. R. has made no move toward a western extension, and probably will not for some time to come.

A CONTRACT for grading 24 miles of the Nanaimo & Esquimault Railroad in Vancouver's Island has been let to Mr. Robert A. Graham.

THE Dominion Government has granted land subsides of 6,400 acres per mile to the Manitoba & Southwestern Railway.

THE New York Elevated Railroads carried 96,688,000 passengers during the year ending Sept. 30th.

GRADING is in progress on the Beech Creek, Clearfield and Southern Road, from Peale, Penn., to Ansonville, and from Peale to Philipsburg. Tracklaying has also been commenced.

CHIEF ENGINEER DEVORE reports nearly sixteen miles of the grading of the Indianapolis, Eel River and Western road so far advanced as to be ready for the cross-ties and rails.

A CORPS of engineers are now at work running and marking the boundary line between the Sioux Indian reservation and the Black Hills.

SURVEYS have been made for an Ontario road, about 100 miles long, formerly chartered as the Nipissing Railway Extension, now called the Irondale, Bancroft and Ottawa.

IT is expected that work will be commenced on the San Antonio and Aransas Pass Railroad before January. The engineers report a very level route.

THE third avenue Railroad Company wants to lay tracks across Broadway, through Vesey to Church St., there to connect with the South Ferry Railroad Company's tracks.

THE tracks of the New York, Philadelphia and Norfolk have reached Eastville. The remaining 13 miles will be completed within a week.

A SCHEME is on foot to build a railroad from the San Miguel Valley, Colorado into Marshall Basin, Col. A slight difference in elevation amounting to 5000 feet will have to be overcome in a distance of 3 miles as the crow flies.

TRACK on the Columbus and Rome railroad has been laid to Stinson, Ga., 4 miles beyond Sulphur Spring, and within 8 miles of Greenville, which place it is expected to reach in November.

ON the Greenwood, Laurens and Spartansburg road, track has been laid from Greenwood, S. C., northeast, as far as Coronaco, 7 miles. It is expected to reach Spartansburg, S. C., by January 1st.

TRACK on the Atlantic and Danville (N.C.) road has been laid to Nottaway River, 11.4 miles beyond Waverly, Va., last year's terminus. Grading is in progress between Nottaway River and Bellfield, 23 miles, and 10 miles are completed. It is expected to reach Bellfield December 1. Tracklaying is delayed at the river for the completion of a bridge 1,200 feet long.

MOST of the rails for the 34 miles of road southward ftom Longview, Tex., to the crossing of the East and West Texas have been received and the grading is nearly completed on the Galveston, Sabine and St. Louis.

A CORPORATION to be known as the Marshfield Construction Company has been organized at Marshfield, Wis. for the purpose of building 40 miles of railroad from that place to Centralia. It is expected to be completed by June 1, 1885.

MR. NELSON BENNETT, who is now engaged on the Yakima division, has been awarded the contract for building 25 miles on the west end of the Cascade division of the Northern Pacific from South Prairie to Green River in Washington Territory. The cost of construction is estimated at $600,000.

THE Wyandotte, Nebraska and Northwestern has been incorporated in Kansas with a capital of $2,000,000 to run from the Kaw River to Cage County, Neb. The incorporators are: E. S. W. Drought, Wyandotte; D. E. Cornell, Wyandotte; S. T. S. Smith, Leavenworth; E. Richardson, Kansas City, Mo.; John D. Cruise, Wyandotte; N. M. McAlpine, Wyandotte.

THE Black Creek Shortline has filed articles of incorporation in Alabama to build a railroad from a point five miles north of Birmingham, on the south and north road, to a point three miles east of Birmingham, on the George Pacific road, with privilege of extending in either direction.

THE track of the Dakota Extension of the Burlington, Cedar Rapids and Northern Railroad is being laid at the rate of nearly two miles a day, and it is expected that it will reach Clear Lake before the 1st of November, and Watertown by the middle of that month.

READING, Penn., Oct. 15.—The Reading and Chesapeake Railroad, the route of which was surveyed two years ago, is now in a fair way of being constructed. The Chief Engineer, S. C. Slaymaker, of Lancaster; D. R. Brewer, representing New York interests, and the Hon. Esaias Billingfelt, of Lancaster, met members of the Board of Trade at the Mansion House to-day, where a conference was held looking to the most practicable approach into this city. The Reading and Chesapeake will run through a rich agricultural district after leaving this city, and will cross the Pennsylvania at Lemon place, follow down the Octarora Valley, crossing the Baltimore Central at Nottingham, thence down the principle Valley to the Chesapeake Bay. It will shorten the distance from Reading to Baltimore 36 miles, and place the City of Lancaster 7 miles nearer. The funds necessary to construct the road are said to be secured.

Miscellaneous.

ESTIMATES for repairing piers at west 35th and west 46th streets this City will be received by the Dock Department till the 24th inst. See *City Record* for particulars.

RECENT paving contracts in Omaha were awarded as follows: Hugh Murphy & Co., Sioux Falls granite $2.98. James Fox, Colorado sandstone, $3.04½.

A CONTRACT has been closed with Messrs. Gordon & Wilson of Vicksburgh, Miss., for the construction of the incline of the crossing of the Mississippi river at Arkansas City. The inclines will be trestling about 1,500 ft. long, about 200 ft. of which will be in the river. It will be located on the Mississippi side, at or near Mound's Landing, the work to be completed in the next sixty days. The same firm was also awarded the contract for protecting the piers of the bridge over the Yazoo River.

THE County Commissioners have opened the bids for the 175 ft. span iron bridge to be built over Eagle creek, in Pike township, Ind. Some of the bidders submitted more than one plan. The following are the bids:

Kennedy Bros., Rushville, plan A, $4,000; plan B, $3,800.

Canton Bridge Company, $22 per lin. ft.

Lomas Bridge Company, Cincinnati, $95.50 per foot.

Champion Bridge Company, Wilmington O., plan A, $25.65 per ft.; plan B. $24.95 per ft.

Massillon Bridge Company, plan A, $24.70; plan B, $24,50; plan C, 17.10; plan D, $23.

Indianapolis Bridge Company, plan A, $22.66; plan B, $21.76; plan C, 16.41; plan D, 16.41

The commissioners have not yet announced their choice.

AN English firm has begun the manufacture of casks and barrels of steel. They are lighter than wood and more durable.

WORK on the new 400 ft. bridge across White River on the Louisville, New Albany & Chicago Railway, will be begun October 15th, the material being nearly all delivered on the ground.

THE following is a more complete description of the new bridge which the N. Y. & N. H. R. R. is building across the Housatonic, than that given Oct. 4th. It is 1,100 ft. long and stands on six piers of masonry 30 ft. in diameter, the draw-bridge span being 180 ft. long and operated by steam. The end posts are 2 ft. in diameter. The piers reach down through water and mud to a solid foundation at a depth of over 30 ft. The entire bridge will weigh 200,000 tons and is built to support a weight of 4,000 pounds to the linear foot, but it is expected to stand a strain of six times that amount. During its construction not a train or a boat has been delayed. The old bridge of cast iron, although in perfect order, can only be sold for old iron, bringing about $23,000. Original cost, eight years ago $137,000. The expense of the entire undertaking will be about $160,000.

THE following is an abstract of the proposals for dredging and repairing east breakwater at Dunkirk Harbor, N. Y.:

Approximate quantities, 37,000 cubic yards of dredging.
Removing old work, 21,000 ft. b. m.
23,400 ft. b. m. white oak.
5,000 lbs. drift bolts.
100 lin. ft. of sheet iron.

Totals of Bids.—L. P. & J. A. Smith, Cleveland, Ohio, $16,296.
George Talbot, Buffalo, N. Y., $11,665.
Contract awarded to Mr. Talbot.

THE following is an abstract of the proposals for widening and deepening the channel at Ashtabula Harbor, Ohio:

Approximate quantities.—Removing 570 lin. ft. old pier.
Dredging, 14,500 cub. yds.
Hemlock, 90,000 ft. b. m.
White pine, 40,000 ft. b. m.
White oak. 3,400 ft. b. m.
Stone filling, 190 cords.
Bolts, screw and washer, 4,000 lbs.
Drift bolts, 13,000 lbs.
Spikes, 900 lbs.
Shore protection. 220 lin. ft.
Mattress work, 50 lin. ft.

Total of bids.—L. P. & J. A. Smith, Cleveland, Ohio, $24,311.
McKenzie & Barrett, Ashtabula, Ohio, $12,891.
Daniel E. Bailey, Buffalo. N. Y., $17,501,
Contract awarded to McKenzie & Barrett.

THE following is an abstract of the proposals for improving the harbor at Ludington, Mich., by placing one crib on pile foundation; opened by Captain Lockwood. We print immediately below a numbered list of the material required, and to each of which we refer by number in the price list:

Material.—
1. 324 lin. ft, of piles, No. 27, for foundation 35 ft. long.
2. 816 ft sheet piles, No, 24, 34 ft. long.
3. 672 ft. B. M, oak.
4. 67.396 ft. B. M. hemlock.
5. 24,312 ft. B. M, pine.
6. 3,500 ft. B. M. pine plank.
7, 1,270 lbs. of S. & W. bolts, complete.
8. 9,697 lbs. of drift bolts and straps.
9. 231 lbs. of wrought spikes.
10. 199 cords of stone.
11. 17½ cords of cedar bark.
12. 17½ cords of brush.
13. 300 cubic yds. of dredging.

Prices. W. R. Laird, Manistee, Mich.: 1. $1.40 per lin. ft.; 2. 39c. per lin. ft. 3. $48 per m; 4. $22 per m; 5. $27. per m; 6. $27 per m; 7, 6c per lb., 8. 4½c. per lb.; 9. 6c, per lb.; 10. $11.80 per cord; 11. $5 per cord; 12. $5 per cord; $13. 55c. per cubic yard. Total, $6.252.35.

Chauncey E. Mitchell, Ludington, Mich.: 1. $1.15 per lin.ft.; 2, 30c. per lin. ft.; 3, $42 per lin. ft.; 4, $15 per m.; 5, $26 per m.; 6, $20 per m.; 7, 8c. per lb.; 8, 5c. per lb.; 9, 6c) per lb.: 10, $12 per cord; 11, $5 per cord; 12, $5 per cord 13; no charge. Total, $5,521.98

Duncan Dewar, Ludington, Mich.: 1, $1 per lin. ft.; 2, 50c. per lin, ft.; 3, $40 per m.; 4, $22 per m.; 5, $26 per m,; 6, $26 per m.; 7, 8c. per lb.; 8, 3c. per lb.: 9, 8c. per lb.; 10, $11 per cord; 11. $4 per cord; 12. $4 per cord; 13, 10c. per cubic yd.

Carkin, Stickney & Cram, East Saginaw, Mich.: 1. $2 per lin, ft.: 2.75c. per lin. ft.; 3. $60 per M; 4, $30 per M.; 5. $40 per M; 6. $30 per M; 7. 8c. per lb.; 8, 5c. per lb.; 9, 5c. per lb.; 10. $15 per cord; 11. $10 per cord; 12. $10 per cord; 13. $1 per cubic yard. Total $8,632.68.

Contract awarded to Chauncey E. Mitchell

THE engineer's report on the improvements of the rivers and harbors in Oregon and Washington Territory for the past year, shows the amount available for the current year $496,000, and the amount asked for the next year $1,928,000.

THE following is an abstract of the bids for repairing the South and Pile Pier at Buffalo Harbor, N. Y.:

Approximate quantities.—Pile Pier—21,000 ft. b. m., of white pine: 12,000 ft. b. m., of white oak; 87 cords of stone filling; 1,700 pounds of spikes; 525 pounds of washers.

South pier—Removing old work, 40,000 ft. b. m. Removing ten old piles, 960 lin. ft. of white oak piles. 106,000 ft. b. m. white oak timber. 15,000 lbs. of bolts, screw and washer. 1,500 lbs. bar iron and washers. 8,000 drift bolts, 5,700 lbs. of spikes.

Total of bids.—Robert W. McIntire, Buffalo, N. Y., $8,554.50.

David W. McConnell, Buffalo, N. Y. $7,098.70.

Daniel E. Bailey, Buffalo, N. Y., $6,899.75.

Louis Harbrecht, Buffalo, N. Y. $7,967.87½.

Contract awarded to Daniel E. Bailey.

THE following is a list of the proposals received and opened by General M. C. Meigs, supervising engineer and architect of the new Pension Building, in answer to advertisement of September 27, 1884, for furnishing 2,500 barrels of cement of 300 lbs. each at the new Pension Building, Washington, D. C.:

W. A. Wheeler, New York city.—Rosendale cement, $1.14 per barrel, or 38c. per 100 lbs.

F. O. Norton, New York city. No price given.

H. W. Blunt, Washington, D. C.—Shepardstown cement, $1.08 per barrel or 36c. per 100 lbs., in sacks, to be returned.

James H. McGill, Washington, D. C.—Rosendale cement, $1.12 per barrel or 37½c. per 100 lbs., and 99c. per barrel and 33c. per 100 lbs.

J. M. Wheatley, Washington, D. C., 41c. and 38c. per 100 lbs.

J. G. and J. M. Waters.—Rosendale cement, $1.25 per barrel or 41½c. per 100 lbs., and $1.33 per barrel and 44½c. per 100 lbs.

ABSTRACT of proposals for constructing 80 lin. ft. of pier, and making general repairs to piers at Fairport Harbor, Ohio, opened at Cleveland, Ohio, by Major Overman:

Materials.—75,955 ft. b. m. hemlock timber and plank.

59,393 ft. b. m. white pine timber and plank.

3,101 ft. b. m. oak timber.

1,051 lin. ft. white oak piles, including driving and cutting off.

128 treenails.

1,200 screw and washer bolts.

5,400 lbs. drift bolts.

1,200 lbs. boat spikes.

350 cords stone for filling and foundation.

500 cub. yds. of dredging.

Total of Bids.—Daniel E. Bailey, Buffalo, N. Y., $7,240.52.

McKenzie and Barrett, Ashtabula, Ohio, $8,797.94.

Courtland D. Merry, Bung Hill, Ohio, $5,887.54.

L. P. and J. A. Smith, Cleveland, Ohio, $6,609.27. No price bid for piles.

John Stang, Lorain, Lorain County, Ohio, $6,402.67.

Contract awarded to C. D. Merry.

THE following is an abstract of the proposals for improving the harbor at Manistee, Mich., by placing one crib on pile form. We give first, a numbered list of the materials required the price of each of which is given in the price list with the number of the item.

Quantities.—1. 324 lin. ft. of foundation piles (No. 27) 35 ft. long.
2. 816 ft. of sheet piles (No. 24) 34 ft. long.
3. 672 ft. b. m., oak.
4. 67,396 ft. b. m., hemlock.
5. 24,312 ft. b. m., pine.
6. 3,500 ft. b. m., pine plank.
7. 1,270 lbs. of S. & W. bolts complete.
8. 9,697 lbs. of drift bolts and straps.
9. 231 lbs. of wrought spikes.
10. 199 cords of stone.
11. 17½ cords of cedar bark.
12. 17½ cords of brush.
13. 300 cub. yds. dredging.

Prices.—W. R. Laird, Manistee, Mich.—1. $1.38 per lin. ft; 2. 36c. per lin. ft.; 3. $45 per m.; 4. $23 per m.; 5. $25 per m.; 6. $25 per m.; 7. 6c. per lb.; 8. 4½c. per lb.; 9. 6c. per lb.; 10 $11.80 per cord; 11. $7 per cord; 12. $7 per cord; 13. $2 per cub. yd. Total, $6,711.91.

Duncan Dewar, Ludington, Mich.—1. $1; 2. 50c.; 3. $40; 4. $24; 5. $26; 6. $26; 7. 8c.; 8. 3c.; 9. 8c.; 10. $11; 11. $4; 12. $4; 13. 75c. Total, $6,064.48.

Carkin, Stickney and Cram, East Saginaw, Mich.—1. $2; 2. 45c.; 3. $50; 4. $29; 5. $33; 6. $26; 7. 8c.; 8. 5c.; 9. 5c. 10. $14; 11. $10; 12. $10; 13. $1. Total, $7,930.58.

Contract awarded to Duncan Dewar.

A CORRESPONDENT of the *Railway Age* writes in reference to the Burlington, Lafayette and Western. "The construction of the roadbed from Kokomo west to Burlington, Ind., a distance of 15 miles, has been let to Mr. James McCarty of Attica, Ind., to be ready for the rails in three months. No bridges on this section are necessary, as the line runs on the water shed between Wild Cat Creek and Deer Creek. The profiles and estimate show a quantity of 150,000 cubic yards of earth to be moved."

THE following is an abstract of proposals for improving harbor at Charlevoix, Mich., opened by Capt. D. W. Lockwood. We give immediately below the quantities of materials called for. Each item is numbered and is referred to by its number in the prices which follow the names of the bidders:

Repairing Plank Beam Revetment.—
1. 1,680 lin. ft. of piles, No. 60, 28 ft. long.
2. 2,304 ft. B. M. pine timber, 12x12.
3. 960 ft. B. M. hardwood, 10x12.
4. 1,110 lbs of S & W bolts.
5. Drift bolts (no quantity specified.)
6. Wrought spikes (no quantity specified.)
7. 35 cords of stone.
8. 300 cords of brush.
9. 300 cords of edgings..

Building Pile Revetment.—
10. 5,660 lin. ft. of piles. No. 250.
11. 29,400 ft. B. M. pine, 12x12.
12. 5,200 ft. B. M. oak or elm, 10x12.
13. 5,136 lbs. S. & W. bolts.
14. 169 lbs, of drift bolts.
15. Wrought spikes; no quantity specified.
16. 25 cords of stone.
17. 250 cords of brush.
18. 250 cords of edgings.

Prices.—Luther E. Allen, Charlevoix, Mich. 1, 18c. per lin. ft.; 2, $29 per M; 3, $35 per M; 4, 7c. per lb.; 5, 4c. per lb.; 6, 7c. per lb.; 7, $7 per cord, 8, $3.50 per cord; 9, $3.50 per cord: 10, 18c. per lin. ft.; 11, $25 per M; 12, $28 per M; 13, 7c. per lb.; 14, 4c per lb.; 15, 7c. per lb.; 16, $6 per cord; 17. $3 per cord; 18, $3 per cord. Total, $6.741.19.

Carkin, Stickney & Cram, East Saginaw Mich., 1,19½c. per lin. ft.; 2, $30 per M; 3, $45 per M; 4, 6½c. per lb.; 5, 4½c. per lb.; 6, 4½c. per lb.; 7, $7 per cord; 8. $5.50 per cord; 9. $5.50 per cord; 10, 19½c. per lin. ft.; 11, $30 per M; 12, $45 per M; 13, 6½c. per lb.; 14, 4½c. per lb.; 15, 4½c. per lb.; 16, $7 per cord; 17, $5.50 per cord. 18, $5.50 per cord. Total, 9,242.75.

Contract awarded to Luther E. Allen.

THE following is an abstract of the proposals for improving harbor at Muskegon, Mich.: by placing one or two cribs on pile foundation. We give a list of materials, to which we refer by the numbers of each item in the list of prices.

Quantities.— 1. 324 ft. of foundation piles (No. 27) 35 ft. long.
2. 816 ft. of sheet piles (No. 24) 34 ft. long.
3. 672 ft. b. m. oak.
4. 67,396 ft. b. m. hemlock.
5. 24,312 ft. b. m. pine.
6. 3,500 ft. b. m. pine plank.
7. 1,270 lbs. of S. & W. bolts, complete.
8. 9,697 lbs. of drift bolts and straps.
9. 231 lbs. of wrought spikes.
10. 199 cords of stone.
11. 17½ cords of cedar brush.
12. 17½ cords of brush.
13. 300 cubic yards of dredging.

Prices.—White & Finch, Grand Haven, Mich.: 1, $1 per linear foot; 2, 30c. per linear foot; 3, $40 per M; 4, $24 per M; 5, $27 per M; 6, $27 per M; 7, 5c. per lb.; 8,5c. per lb.; 9,5c. per lb.; 10, $11 per cord; 11, $4 per cord; 12, $4 per cord; 13, 60c. per cubic yard. Total, $6,033.

Knapp & Gillen, Racine, Wis.: 1. 90c.: 2, 25c.: 3, $40.; 4. $23; 5, $28; 6, $18; 7, 6c.; 8, 4½c.; 9, 5c.; 10, $12; 11, $4; 12, $4; 13, 40c. Total, $5,988.42.

George Talbot, Buffalo, N. Y., 1, $1.10; 2, 25c. 3, $40; 4, $24; 5, $30; 6, $25; 7, 5c.; 8, 4c.; 9. 4c.; 10, $12; 11, $5; 12, $5; 13, $1. Total, $6,345.26.

Petrie Lumber Co., Muskegon, Mich., 1, 80c.; 2, 30c.; 3, $35; 4, $20; 5. $24; 6, $20; 7, 8c.; 8, 4½c.; 9, 4c.; 10, $10.50; 11, $3; 12, $3; 13, 50c.; per cub. yd. Total, $5,420.63.

Thomas W. Kirby, Grand Haven, Mich., 1, 95c.; 2, 20c.; 3, $40; 4, $24; 5, $29; 6, $26; 7. 6c.; 8. 4½c.; 9, 5c.; 10, $11.50; 11, $4; 21, $4; 13, 75c.; Total, $6,089. 04.

Hiers B. Herr, Chicago, Ill.. 1, $1; 2, 20c.; 3, $30; 4, $20; 5, $23; 6, $22; 7, 5c.; 8, 4c.; 9, 5c.; 10, $11; 11, $3; 12, $3; 13, 35c, Total, $5,353.39.

Carkin, Stickney & Cram, East Saginaw, Mich., 1, $1.25; 2, 22c.; 3, $45; 4, $24; 5, $28; 6, $22; 7. 8c.; 8. 5c.; 9, 5c,; 10, $14; 11, $6; 12, $6; 13, $1. Total, $6,908.48.

Contract awarded to Hiers B. Herr.

THE following is an abstract of the bids for dredging in Schuylkill River, Pa.;

National Dredging Co., Wilmington, Del., 28c. per cub. yd.

American Dredging Co., Philadelphia, Pa., 31½c. per cub. yd.

Contract awarded to the National Dredging Co.

THE following is an abstract of the proposals for improving harbor at Grand Haven, Mich., by placing three or four cribs on pile foundations. We first give a list of material required. Each item is numbered and in the list of prices is referred to by its number:

Quantities.—
1. 324 ft. of foundation piles (No. 27) 35 ft. long.
2. 816 ft. of sheet piles (No. 24) 34 ft. long.
3. 672 ft. b. m. of oak.
4. 67,396 ft. b. m. of hemlock.
5. 24,312 ft. p. m. of pine.
6. 3,500 ft. b. m. of pine blank.
7. 1,270 lbs. of S. & W. bolts, complete.
8. 9,687 lbs. of drift bolts and straps.
9. 231 lbs. of wrought spikes.
10. 199 cords of stone.
11. 17½ cords of cedar bark.
12. 17½ cords of brush.
13. 300 cub. yds. of dredging.

Prices.—Carkin, Suckney & Cram, East Saginaw, Mich.: 1, $1.25 per linear foot; 2, 25c. per linear foot; 3, $45 per M; 4, $26 per M; 5, $30 per M; 6, $24 per M; 7, 8c. per lb.; 8, 5c. per lb.; 9, 5c. per lb.; 10, $12 per cord; 11, $6 per cord; 12, $6 per cord; 13, 60c. per cub. yd. Total, $6,580.90.

White & Finch, Grand Haven, Mich.: 1, $1; 2, 30c.: 3, $40; 4, $24; 5, $26; 6, $26; 7, 5c.; 8, 5c.; 9, 5c.; 10, $11; 11, $4; 12, $4; 13, 60c. Total, $6,005.19.

Hiers B. Herr, Chicago, Ill.: 1, $1: 2, 20c.; 3, $30; 4, $20; 5, $23; 6, $22; 7, 5c.; 8, 4c; 9, 5c.; 10, $11; 11, $3; 12, $3; 13, 35c. Total $5,353.39.

Knapp & Gillen, Racine, Wis.—1, 90c.; 2,25c.; 3, $30; 4, $22; 5, $28: 6, $18: 7, 6c.; 8, 4½c; 9, 5c.; 10, $11.50: 11, $4: 12, $4; 13,40c. Total $5,814.82.

George Talbot, Buffalo, N. Y.—1, $1.10: 2, 25c.; 3, $40; 4, $24; 5, $30; 6, $25: 7, 5c.; 8, 4c.; 9, 4c.; 10, $12; 11, $5; 12, $5; 13, 90c. Total $6,315.18.

Thomas W. Kirkby, Grand Haven, Mich.—1, 90c: 2, 20c.: 3, $30; 4, $22; 5, $27; 9, $24; 7,5c.; 8, 4c.; 9, 5c.: 10, $11; 11, $3; 12, $3; 13, 45c.; Total, $5,590.02.

Contract awarded to Hiers B. Herr.

THE following is an account of a sewerage system proposed by Mr. James M. Saylor to remove what is known as the Back Bay nuisance at Portland, Me.:

"At Deering's bridge is to be constructed a reservoir, the bottom of which is 3 ft. above low tide. A wooden tunnel 4½ ft. by 4½ ft. connects this reservoir with the brick tunnel. At the end of this wooden tunnel a gate is constructed. This gate is kept fastened by means of a floating platform, on top of which is a wooden bolt. When the tide first commences to rise, this platform and bolt also rise, and secure this gate. Now the tide opens two gates and fills the reservoir. Opposite these gates in the reservoir are two floating platforms. These platforms are connected with the gates by a chain. When the tide is within one hour of low tide the floating platform and bolt descend, and the pressure of the water in the reservoir against the gate opens it, allowing the full force of water, equal to 20 horse power, from the reservoir to rush into the tunnel. As the water in the reservoir lowers the floating platforms in the reservoir fall, and by means of the chains which pass over pullies open the gates in the reservoir, allowing the rest of the water to pass out into the bay. By means of this method of construction the sewage of the tunnel is cleaned out and all deposits carried out from 1 to 2 miles into the ocean twice in 24 hours. The tunnel being laid in the streets, it is easy of access.

"Mr. Saylor's system of sewerage contemplates the construction of a brick tunnel with a flat bottom and a segmentally arched top. This tunnel, which is to be of brick laid in Portland cement, is to be 4½ ft. wide and 5 ft. high inside, this capacity of tunnel being calculated as of sufficient capacity to thoroughly drain the entire present and contemplated northern portion of the city.

"This tunnel is to start at Deering's bridge, extending through Kennebec, Wilmot and Lincoln streets to Smith and along the water's edge of Munjoy Hill to the shore below Tukey's bridge. There will be connected with this tunnel a wooden tunnel 150 ft. long, 100 ft. of which will be laid about level with the low tide and the remaining 50 ft. will be laid on an incline; the extreme end being 1 ft. below the lowest tide. It is proposed that all sewers now built or contemplated on the northern side of the city shall enter and discharge in this tunnel. Any sewer above high water can discharge into this tunnel. This tunnel is to have two openings for the reception of the deposits of night carts, also a sufficient number of openings or man-holes in case of accidents.

"The cost of the above described tunnel and reservoir, the tunnel being estimated at 1½ miles in length, finished complete, $69,500.

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